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ABSTRACT

This volume provides an overview of the duties, procedures, concepts, tools, and equipment used in automotive body refinishing. It supplements the first volume of this series ("Introduction to Auto Body") and complements the other manuals that cover body repair and frame repair. Suitable for secondary, postsecondary, and adult classes, this guide is easily adaptable to open-entry, open-exit programs to allow students to progress at an individual pace. This curriculum guide contains six units with eight basic components for each unit: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. (Depending on the specific objectives, there may or may not be transparency masters, supplements, assignment sheets, or job sheets included in the unit of instruction.) All of the unit components focus on measurable and observable learning outcomes and are designed for use in more than one lesson or class period of instruction. The following topics are covered in the six units: refinishing eqiupment; preparing surfaces for paint; masking; mixing and applying undercoats; mixing and applying topcoats; and detailing. (KC)

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Automotive Body Refinisher

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Developed by
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FOREWORD

In Oklahoma, vocational educators have a basic belief that quality vocational programs require the use of sound instructional materials. A comprehensive approach with a quality treatment served as the primary strategy when the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center began revisions of its instructional guide for the auto-body trade. This volume, *Automotive Body Refinisher*, provides students in this area with an overview of the duties, procedures, concepts, tools, and equipment used in body refinishing. It supplements the first volume of this series, *Introduction to Auto Body*, and complements the other manuals that cover body repair and frame repair. Throughout the series, every effort has been made to address the latest in technology with a special concern for the safety and health aspects associated with auto-body occupations.

Industry representatives, educators, and technical specialists collaborated closely to produce these materials in the hope that students will gain the knowledge and skills required in the auto-body trade through practical learning experiences. Coupled with the instructor's own methods and expertise, the materials should prove to be a valuable asset for a progressive auto-body training program.

It is our sincere wish that the manuals in this series will contribute to the development of a competent, safety-conscious work force in the auto-body trade.

Roy Peters, Jr., Director
Oklahoma State Department of
Vocational and Technical Education

Ivan Armstrong, State Supervisor
Trade and Industrial Education
Oklahoma State Department of
Vocational and Technical Education

PREFACE

The purpose of *Automotive Body Refinisher* is to continue the student's training in the autobody trade by providing instruction in this specialty area. Instructional materials are also being developed for body repair, frame repair, and shop management. Each volume has been carefully reviewed and validated by a committee of industry and education representatives concerned with presenting the latest advances of the trade.

These curriculum materials have been designed for use in full-time secondary and post-secondary classes, as well as part-time adult classes. The material is easily adaptable to open-entry, open-exit programs to allow students to progress at their individual paces.

A skilled instructor will be able to supplement, personalize, and localize this material to meet specific training needs. The design of the material allows the different topics to be presented in a variety of sequences, and even permits the use of part of a unit of instruction at a given time. The "Use of this Publication" section will greatly aid the instructor and student in getting the most from these materials. Additionally, the CIMC staff will be glad to assist you in tailoring these materials to your needs.

Bob Patton, Coordinator
Curriculum and Instructional
Materials Center
Oklahoma State Department of
Vocational and Technical Education

ACKNOWLEDGEMENTS

Any project as comprehensive and involved as this guide for teaching auto-body refinishing requires the contributions of a great number of people. I am thankful for the tremendous support I have received in the development of this book. Special thanks is given to James VanWinkle, instructor at Tulsa County Area Vo-Tech School, who served as technical advisor and development consultant for this project. James' advice and contributions were largely responsible for the design and content of this volume.

Throughout the development of this book, I was also guided by an able panel of experts from both the industry and education. This committee designed the scope and sequence of all the materials contained in this series and reviewed the completed materials for technical accuracy, teachability, currency, and industry relevance. I am especially grateful for the assistance given by representatives of the Independent Automotive Service Association and the Inter-Industry Conference on Automotive Collision Repair (ICAR). The review committee included

Mike Avant
Auto-Body Instructor
Indian Meridian Area
Vo-Tech School
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Jim Blankenship
Zone Chairman ICAR
Owner and President
Jim Blankenship Body Shop
Tulsa, Oklahoma

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J. C. Dew
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Auto-Body Instructor
Northeast Area
Vo-Tech School
Pryor, Oklahoma

Ron Wood
Owner and President
R and M Body Shop
Chickasha, Oklahoma

I am glad also to acknowledge the contributions and assistance given by Judy Scott of The Paint Place of Stillwater, Oklahoma. She and her staff spent many hours answering technical questions and providing us with tools and materials used in producing illustrations for this volume. Similarly, Mike Avant and the staff and students of Indian Meridian Area Vo-Tech school deserve special recognition for allowing the use of their shop for photography procedures. I would also like to thank the Ditzler Division of Pittsburgh Plate Glass for allowing us to use their "Troubleshooter's Guide."

I owe a great deal of gratitude to members of the Oklahoma State Department of Vocational and Technical Education staff who made the project possible, especially to Roy Peters, Jr., State Director; Ivan Armstrong, Trade and Industrial State Supervisor; and Bob Patton, CIMC Coordinator. These men recognized the need for these materials and dedicated the resources to see that the project was completed. I gratefully recognize the contributions of Dean Myers, who represented the Trade and Industrial Division, and Robert Hilley, who assisted with this project while coordinating production and co-authoring other books in this series.

I am also thankful to the many people involved in the production process. I received editorial guidance and assistance from the editing staff, supervised by Terri Barnes; thanks to Sue Buck, Jerry Weir, and Marsha Sneed. I am also grateful to those in the Communications Center, under Debbie Hixson, who prepared the many drafts of this manual, with special thanks to Rose Primeaux, Stephanie Smola, and Lisa Tomlinson.

The illustrations for this publication came from a number of sources. The CIMC is thankful to the many companies and publishers who contributed artwork, identified by the permission lines accompanying many of the illustrations. We are also grateful for the work done by the Art Department, under Bob Davis, and especially to Gary Bradley, Kim Hale, Kathryn Hansen, Robert Randall, and Suzi Morris, who served as illustrators on this project. Recognition also is due to Tom Fields of the CIMC Media Unit who did the photographic work for this volume.

The quality of the published product is the result of the care and talents of the Print Shop personnel under the supervision of Noel Wilcoxson. And finally, none of this would have been possible without the dedication and skills of the CIMC secretarial staff under Judy DeVaughan, and especially the assistance of Janette Nicholson and Anita Kroth, secretaries to the Development Unit. To these and many others, I am extremely grateful to have shared in this team effort.

It is my sincere hope that these materials will be of value to auto-body instructors and that they benefit those students who pursue careers in this vital and rewarding field.

Susan Walker

Instructional Units

Automotive Body Refinisher contains six instructional units. A standard format was established in 1970 for development of instructional materials for all Oklahoma vocational teachers. This format includes eight basic components that form a unit of instruction: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may or may not be transparency masters, supplements, assignment sheets, or job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help him or her determine the following

- Amount of material that can be covered in each class period
- Skills that must be demonstrated
  - Supplies and equipment needed
  - Amount of practice needed
  - Amount of class time needed for demonstrations
- Supplementary materials, such as pamphlets and filmstrips, that must be ordered
- Resource people to contact

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the performance necessary to reach the unit objective. Since the objectives of the unit provide direction for the teaching/learning process, it is important that teachers and students have a common understanding of the intent of the objectives.

The objective sheet should be given to students and referred to throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may also be used as a quick pretest to determine students' prior knowledge and to determine whether further study or activities are necessary. Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages)

Suggested activities are included only in teacher materials. The suggested activities pages include an outline of the unit contents and an instructor's guide designed to assist teachers in planning their presentation of the unit. The instructor's guide provides suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed in the suggested activities are ones used in the development of each unit. They may be used by the teacher to supplement her or his knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

The suggested activities section of the unit also includes supplements and transparency masters. Each of these components provides information in a special way. Supplements may consist of motivational materials, review or practice materials such as crossword puzzles and self-tests, or charts and reference materials. Supplements are designed to be copied and distributed to individual class members or to the class as a whole. Suggestions for their use are included in the instructor's guide. Transparencies direct the class' attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification or analysis is necessary. Order transparencies from the Curriculum and Instructional Materials Center, or make transparencies and place them in the notebook where they will be immediately available for use.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical-outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide motivation for each unit.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience. They assist students in the application of knowledges that are necessary prerequisites to skill development. Assignment sheets may be given to the student for completion in class or may be used for homework assignments. Answer sheets are provided when appropriate and can be used by the student and/or teacher for checking student progress. The scores of those assignment sheets listed in the specific objectives should be averaged with the unit test score, as the skills addressed in these assignment sheets are considered necessary in meeting the unit objective.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

The teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Job sheet performance should be evaluated by the instructor and averaged with the unit test score, as the skills addressed in the job sheets are considered necessary in meeting the unit objective.

Tests (yellow pages)

The test provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test, 85 percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each question. The final unit grade should be obtained by using the paper/pencil score and evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

Answers to test and assignment sheets are components designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center (CIMC) is assigned a specific abbreviation. For example, *Automotive Body Refinisher* has been abbreviated ABRF. The units are then numbered consecutively within each section. An example of a page number is ABRF-1. Since CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Methods of Disseminating Material

Material may be given out a unit or page at a time to keep the material before the student always new. Some teachers ask students to furnish a three-ring binder for the units. This is convenient for taking the materials home to study. Upon completion, each unit is then placed in a larger binder. The large binders may be purchased at cost from the CIMC. Some teachers store the materials by units in filing cabinets or boxes until needed. All the units may be given out at once if desired.

For best results, provide student materials for each student. Student materials contain everything but the test answers, answers to assignment sheets, and suggested activities. All tests are collated at the back of student material and should be removed and stored until needed.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

Competency Profiles

Competency profiles are folders used to document student performance. The profile contains a list of the specific job competencies that a student should achieve prior to leaving the training program. Competency profiles may be ordered from the State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.

CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. You can mail the information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, it is important that you notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Manager of Development
Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and
Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074

REFINISHING EQUIPMENT
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to identify and safely use various types of refinishing equipment. The student will show this ability by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with refinishing equipment.
2. Identify and describe auto-body refinishing equipment.
3. Label the parts of a suction-feed spray gun.
4. State general safety rules for refinishing equipment.
5. Select from a list guidelines for maintaining an air compressor.
6. Demonstrate the ability to
   a. Fill a suction-feed spray gun and set correct pressure, fan pattern, and fluid flow.
   b. Clean a suction-feed paint gun.
   c. Clean and service paint booth filters.
   d. Drain moisture from a separator-regulator.
   e. Drain and service an air compressor.

REFINISHING EQUIPMENT
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Transparencies

1. TM #1 — How the Suction-Feed Paint Gun Works
2. TM #2 — Principal Parts of the Spray Gun
3. TM #3 — Spray Gun and Points of Lubrication
4. TM #4 — Spray Patterns
5. TM #5 — Paint Problems from Improper Handling of Paint Gun

D. Information sheet

E. Assignment sheets

1. Assignment Sheet #1 — Solve Percentage Problems
2. Assignment Sheet #2 — Solve Basic Ratio and Proportion Problems

F. Answers to assignment sheets

G. Job sheets

1. Job Sheet #1 — Fill a Suction-Feed Spray Gun and Set Correct Pressure, Fan Pattern, and Fluid Flow
2. Job Sheet #2 — Clean a Suction-Feed Paint Gun
3. Job Sheet #3 — Clean and Service Paint Booth Filters
4. Job Sheet #4 — Drain Moisture from a Separator-Regulator
5. Job Sheet #5 — Drain and Service an Air Compressor

H. Test

I. Answers to test

pink

SUGGESTED ACTIVITIES

II. Instructor's guide

A. Review unit and plan presentation.

B. Order or obtain equipment and materials to supplement unit.

1. Equipment and materials for job sheet procedures

2. Examples of each piece of equipment listed in Information Sheet, Section II

3. Filmstrips and transparencies

(NOTE: The following filmstrips and transparencies are available from Teaching Aids Inc., Post Office Box 1798, Costa Mesa, California 92628-0798.)

a. *Paint Equipment*

(NOTE: This filmstrip [33 frames], cassette, and work sheet provide instruction in the use of paint guns, paint booths, air regulators, and air hoses. The filmstrip also covers the difference between suction-feed and pressure-feed paint guns, and the maintenance of spray equipment.)

b. *Spray Refinishing Equipment*

(NOTE: This program considers the variety of compressor and spray gun types and their incorporation into a workshop situation.)

c. *Auto Body Painting*

(NOTE: This complete series of transparencies covers all facets of auto-body painting. Transparencies include *Paint and the Paint Shop:* Paint Ingredients, Masks and Goggles, Paint Booths, Drying Equipment; *Spraying Equipment:* The Spray Gun, Cleaning a Spray Gun, Spray Gun Troubles, Spraying Systems; and series on *Surface Preparation*, *Paint Conditions*, *Painting*, *Treatment After Painting*, and *Special Effects*.)

4. Filmstrip projector and overhead projector

5. Competency profiles

(NOTE: Competency profiles for this manual are available from the State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

C. Provide students with unit.

SUGGESTED ACTIVITIES

D. Introduce unit by reviewing the unit and specific objectives. Explain how mastery of the specific objectives leads to accomplishment of the unit objective.

E. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I to introduce students to terms associated with refinishing equipment.

2. Use Information Sheet, Section II to acquaint students with various pieces of refinishing equipment.

   SUGGESTIONS:

   - Show students an example of each piece of equipment. Demonstrate how the equipment is put together or how it works when applicable.

   - Show filmstrip *Painting Equipment*. Critique and discuss with the class.

3. Use Information Sheet, Section III to introduce students to the basic parts of a spray paint gun.

   SUGGESTIONS:

   - Show students examples of different types of spray guns.

   - Point to different parts of a typical spray gun and have students tell you the name and function of each part

   - Allow students to complete Assignment Sheets #1 and #2 to practice calculating paint percentages and proportions.

4. Use Information Sheet, Section IV and V to discuss safety rules to follow when using refinishing equipment and guidelines for compressor maintenance.

   SUGGESTIONS:

   - Show filmstrip *Spray Refinishing Equipment*.

   - Relate accidents that have occurred because of carelessness or failure to follow safety rules. Have studnets relate accidents that they know of. Discuss how such accidents could have been prevented.

   - Review guidelines for maintaining an air compressor, and then demonstrate Job Sheet #5 and have students complete this job sheet under your supervision.

5. Discuss and demonstrate Job Sheets #1 through #4. Assign completion dates, and have the students complete the job sheets under your supervision.

F. Give test.

G. Critique test and discuss in class.

H. Complete appropriate section of competency profiles.

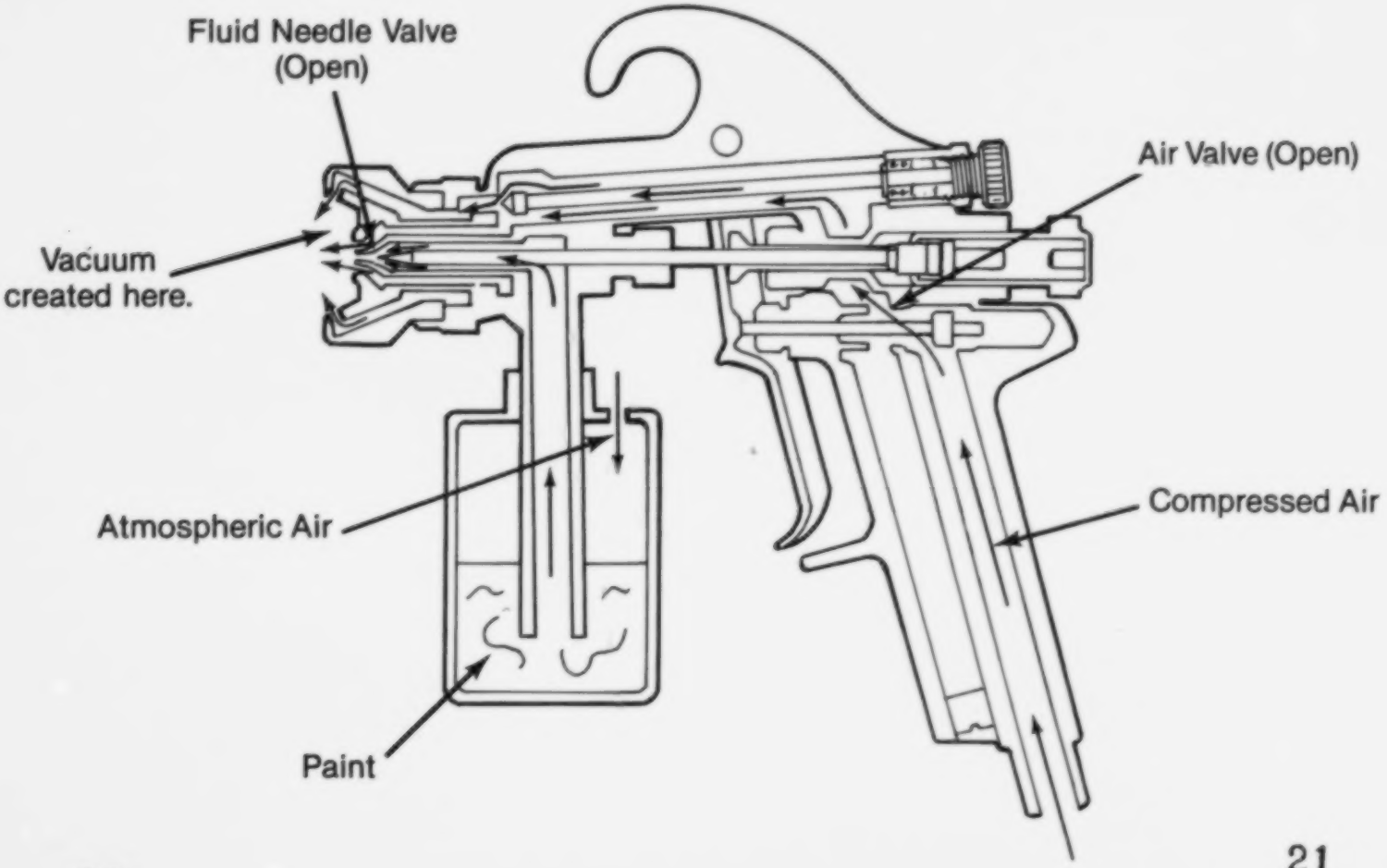
III. Unit references

A. Crouse, William H., and Donald L. Anglin. *Automotive Body Repair and Refinishing*, 2nd ed. New York: Gregg Division of McGraw-Hill Book Company, 1986.

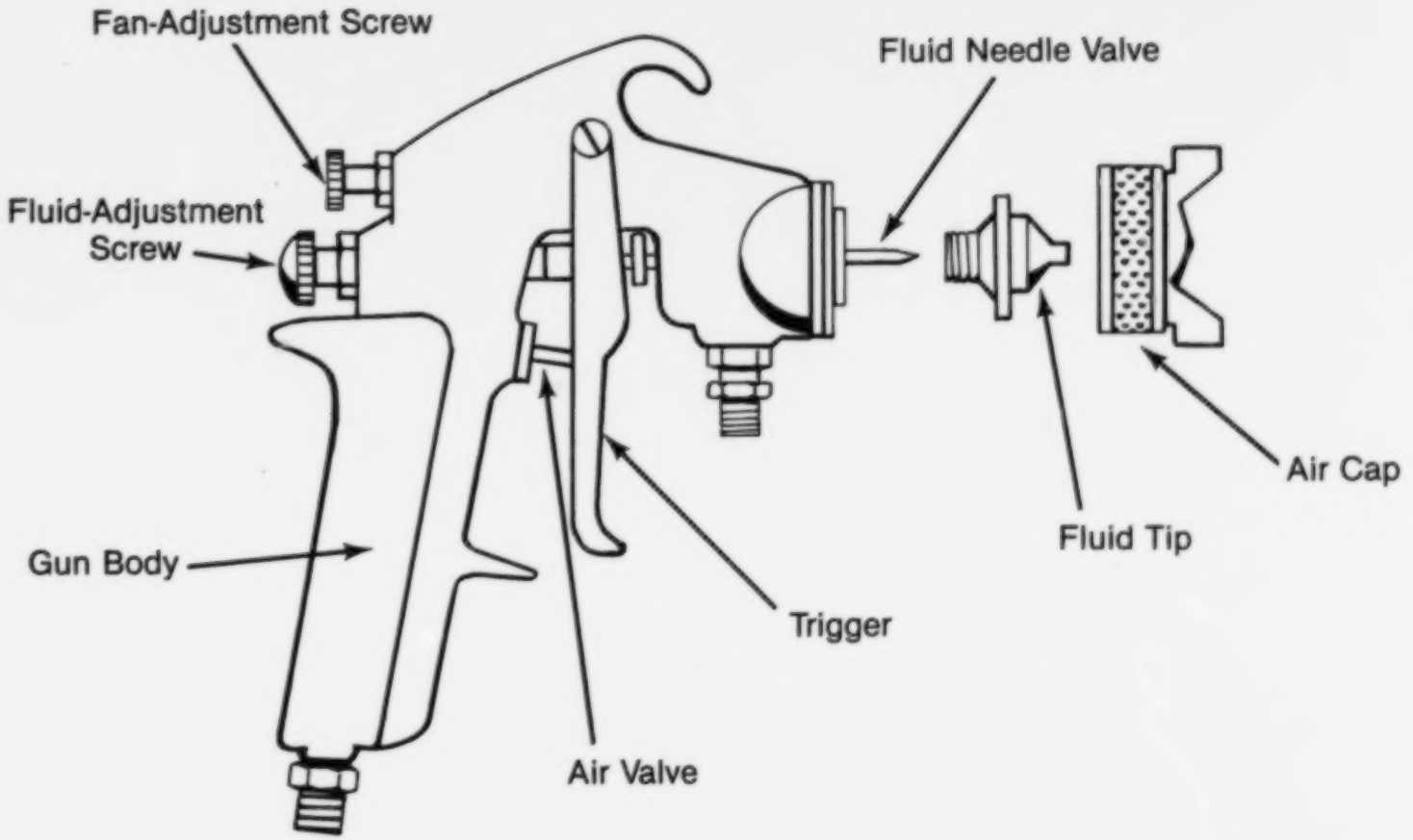
B. Manual, Edward F., and Wayman R. Penner. *Auto Body Repair and Repainting.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, 1974.

C. Rhone, L.C., and H. David Yates. *Total Auto Body Repair*, 2nd ed. Indianapolis: Bobbs-Merrill Educational Publishing, 1983.

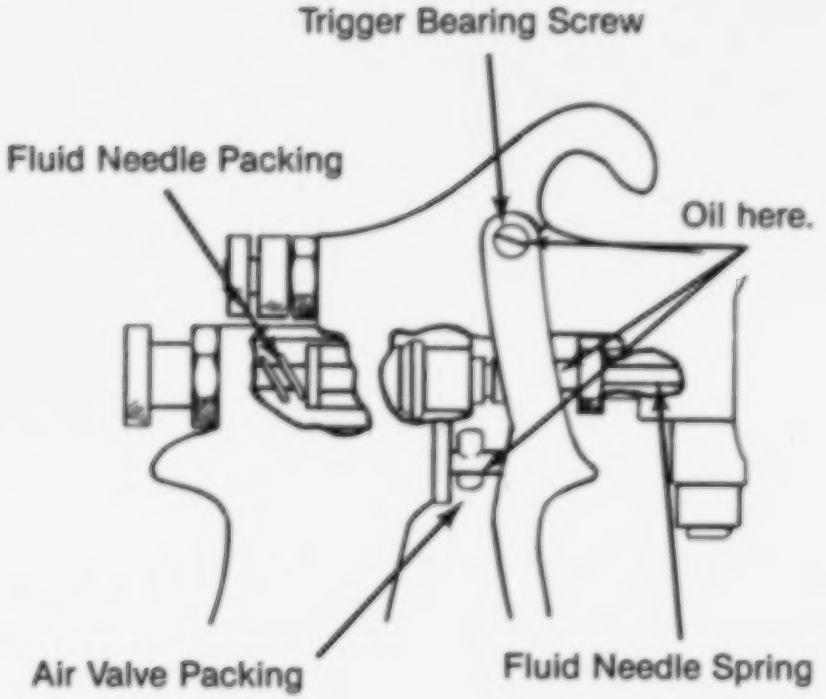
How the Suction-Feed Paint Gun Works



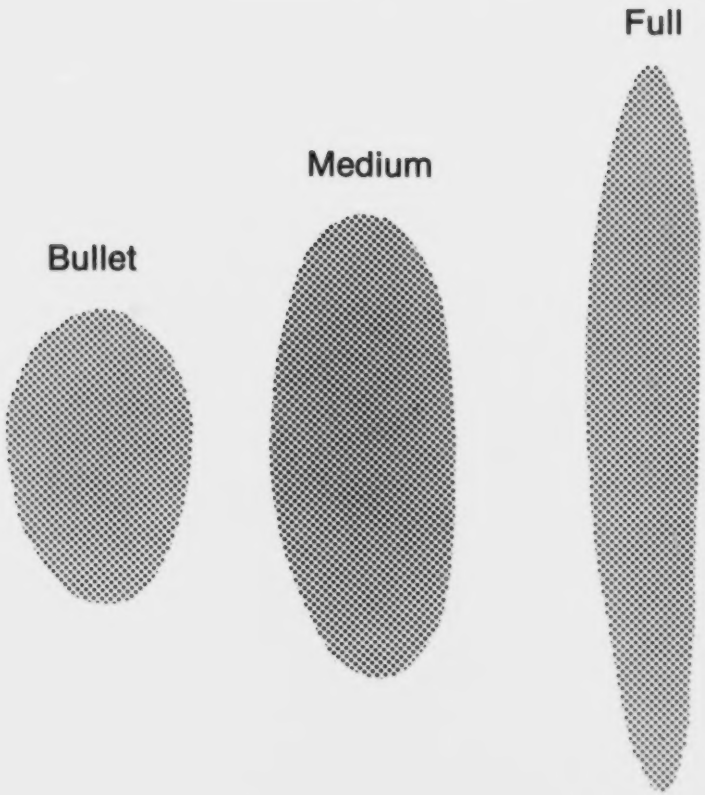
Principal Parts of the Spray Gun



Spray Gun and Points of Lubrication

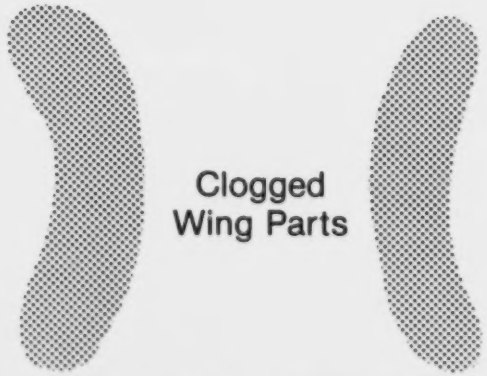


Spray Patterns



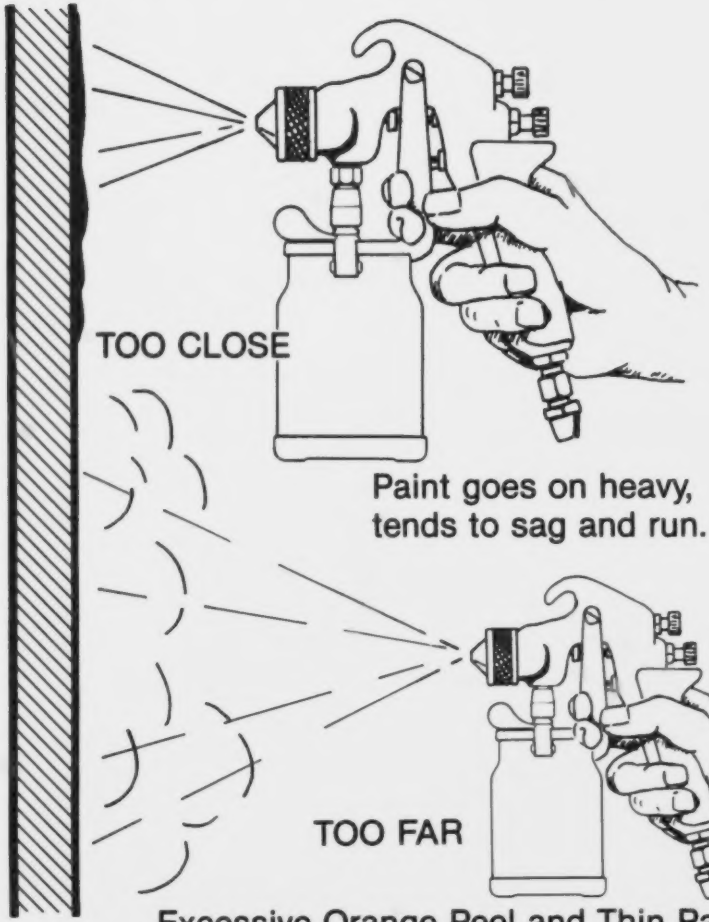
The Progression of a Fan Pattern Adjustment

Clog at Fluid Tip on Air Cap
Material Opening, Center Orifice



Faulty Spray Patterns

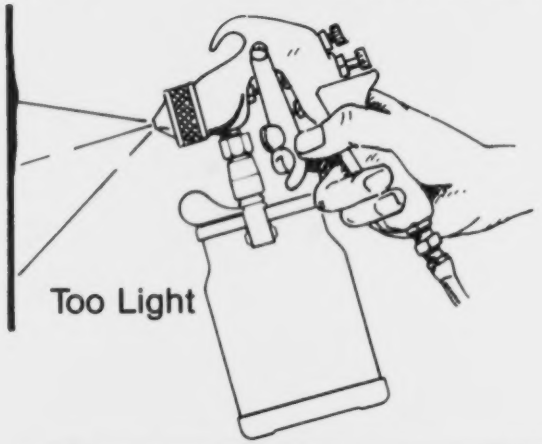
Paint Problems from Improper Handling of Paint Gun

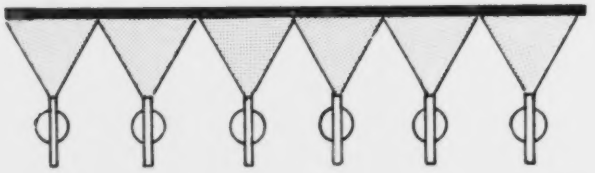


Excessive Orange Peel and Thin Paint Film

Too Heavy

TILTING THE GUN





Keep gun parallel to surface.

Do not arc gun.

REFINISHING EQUIPMENT
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Siphon — To use a tube to carry liquid out of a container, using only force of atmospheric pressure on surface of liquid

B. Viscosity — Resistance to flow; thickness of a liquid

C. Hydrophobic — Quality of wax that causes it to reject water

D. Rubbing compound — Abrasive paste that smooths paint film

E. Tack rag — Cloth saturated with diluted varnish to make it sticky so that it will pick up dust and dirt particles

F. Atomization — Process of changing liquid into fine droplets

G. Agitate — To stir or shake up, as with paint

H. Air controller — Air-pressure gauge with built-in regulator that can be adjusted to set desired pressure in paint gun

I. Oscillating — Moving back and forth

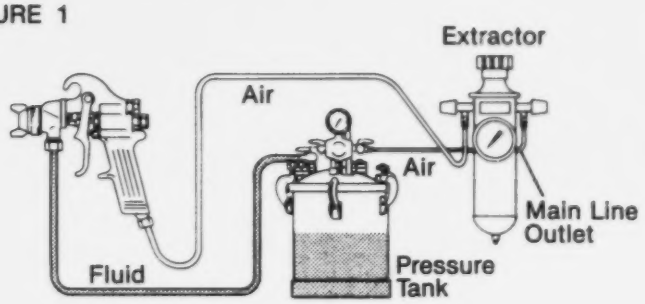
J. Orbital — To move in a circular pattern

K. Pigment — Coloring matter

II. Refinishing equipment (Figures 1-18)

A. Pressure-feed spray gun — Paint atomizer in which compressed air forces paint from a pressure tank, through a tube to the gun, and out the gun tip; used on large jobs such as trucks and buses

FIGURE 1



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INFORMATION SHEET

B. Suction-feed spray gun — Paint atomizer in which compressed air flows through a small opening around fluid tip in gun cap, creating a slight vacuum and allowing atmospheric pressure to push paint up and out

(NOTE: The suction-feed spray gun is also called a *siphon-feed spray gun* or a *siphon gun*.)

FIGURE 2

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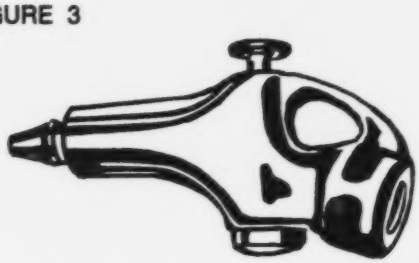
C. Blow gun — Small compressed air nozzle used with air compressor to blow dust and dirt from cracks and surface of vehicle

FIGURE 3



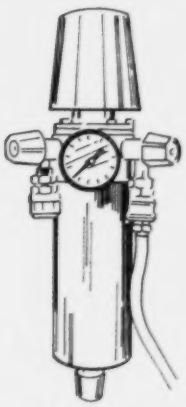
INFORMATION SHEET

D. Air brush — Small paint atomizer designed for small, intricate jobs and for touch-up work

FIGURE 4

E. Air regulator with water trap — Used to supply spray equipment with clean, dry air and to regulate air pressure; separates oil and water from air

FIGURE 5



F. Air compressor — Source of compressed air for spray guns and brushes

FIGURE 6

INFORMATION SHEET

G. Paint paddle — Metal, wood, or plastic implement used to stir paint to evenly mix ingredients

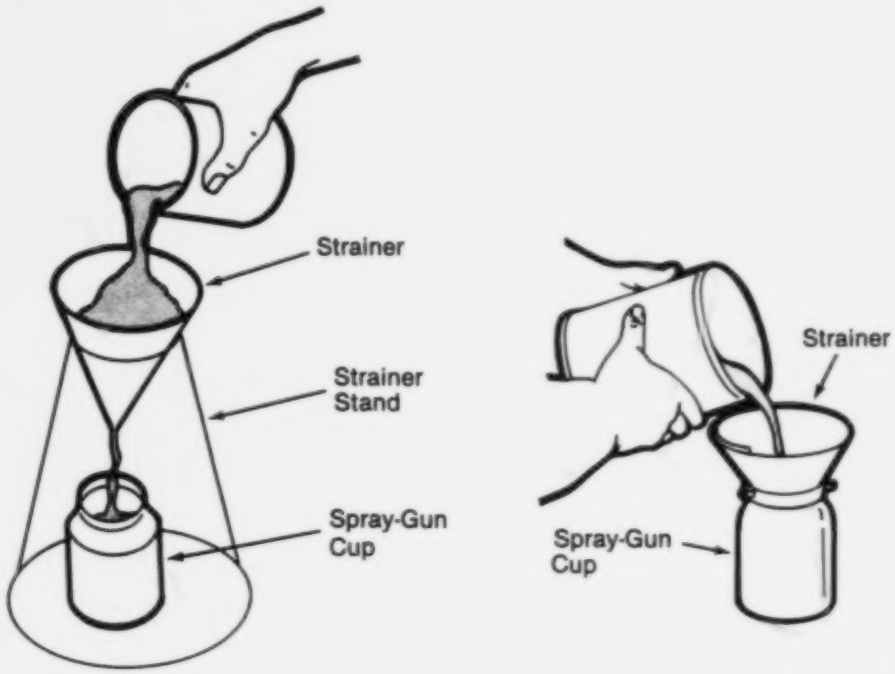
(NOTE: Use a paddle made of the material recommended by the paint manufacturer.)

FIGURE 7

H. Paint strainer — Funnel-shaped cone used to strain out any dirt, lumps, or scum in paint as it is poured into spray gun; may be made of mesh, fiber, wire, or disposable filter paper

(NOTE: If metallic paint is strained through too fine a filter, the metal flakes in the paint will be removed.)

FIGURE 8



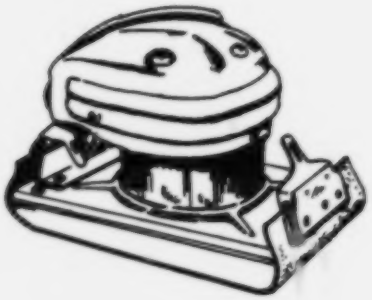
INFORMATION SHEET

I. Viscosity cup — Special measuring device that allows the technician to determine thickness or flow of paint to compare to specifications

FIGURE 9

J. Orbital sander — Used to smooth metal and to sand and featheredge paint

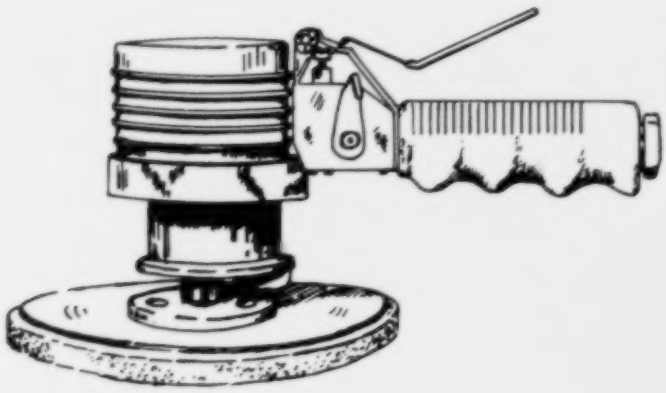
FIGURE 10



INFORMATION SHEET

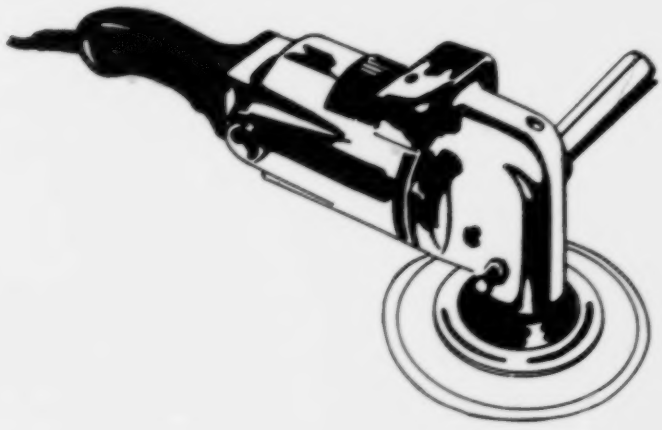
K. Oscillating sander — Used to remove paint

FIGURE 11



L. Buffer — Power tool with felt wheel used to apply abrasive compounds

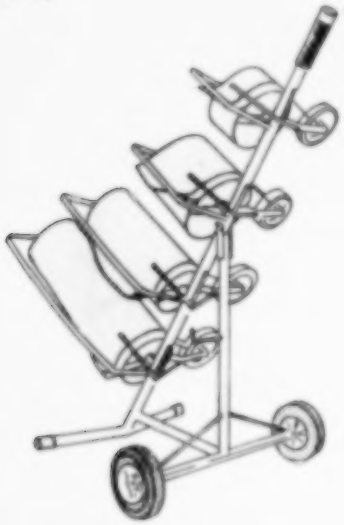
FIGURE 12



INFORMATION SHEET

M. Apron taper — Machine designed to hold masking paper and tape; as paper is pulled off roll, tape is dispensed to edge of paper, making an apron or overlap

FIGURE 13



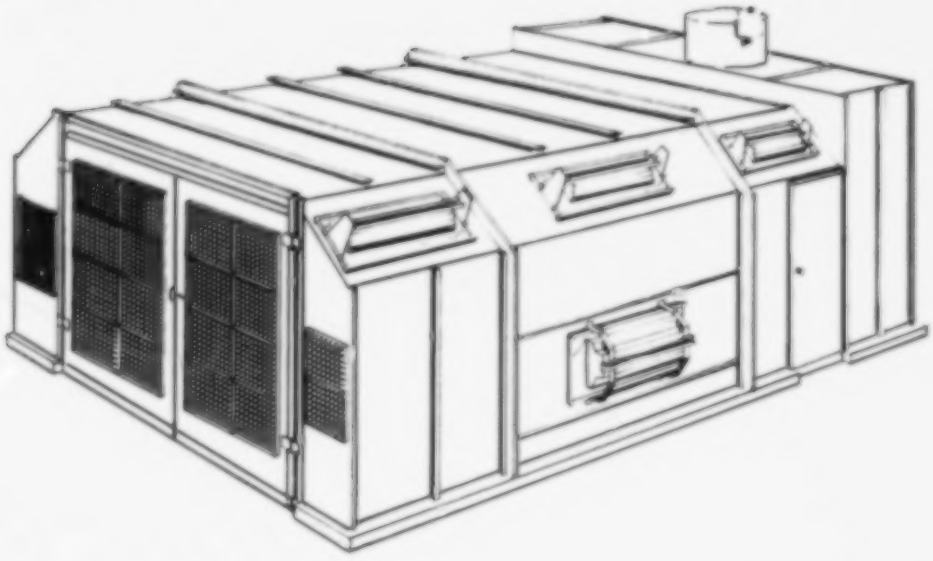
N. Sanding block — Block to which abrasive is attached to evenly distribute pressure when hand sanding

FIGURE 14

INFORMATION SHEET

O. Paint booth — Totally enclosed, dirt-free and dust-free environment in which to paint vehicles

FIGURE 15



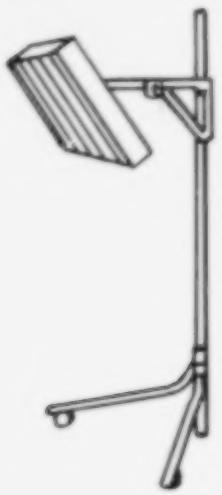
P. Panel drying system — Used to force heat and hot, dry air over vehicle panel

FIGURE 16

INFORMATION SHEET

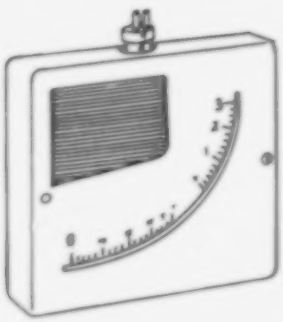
Q. Spot repair drying system — Used to force heat and hot, dry air over small area of vehicle

FIGURE 17



R. Draft gauge — Used to measure flow of air in paint booth

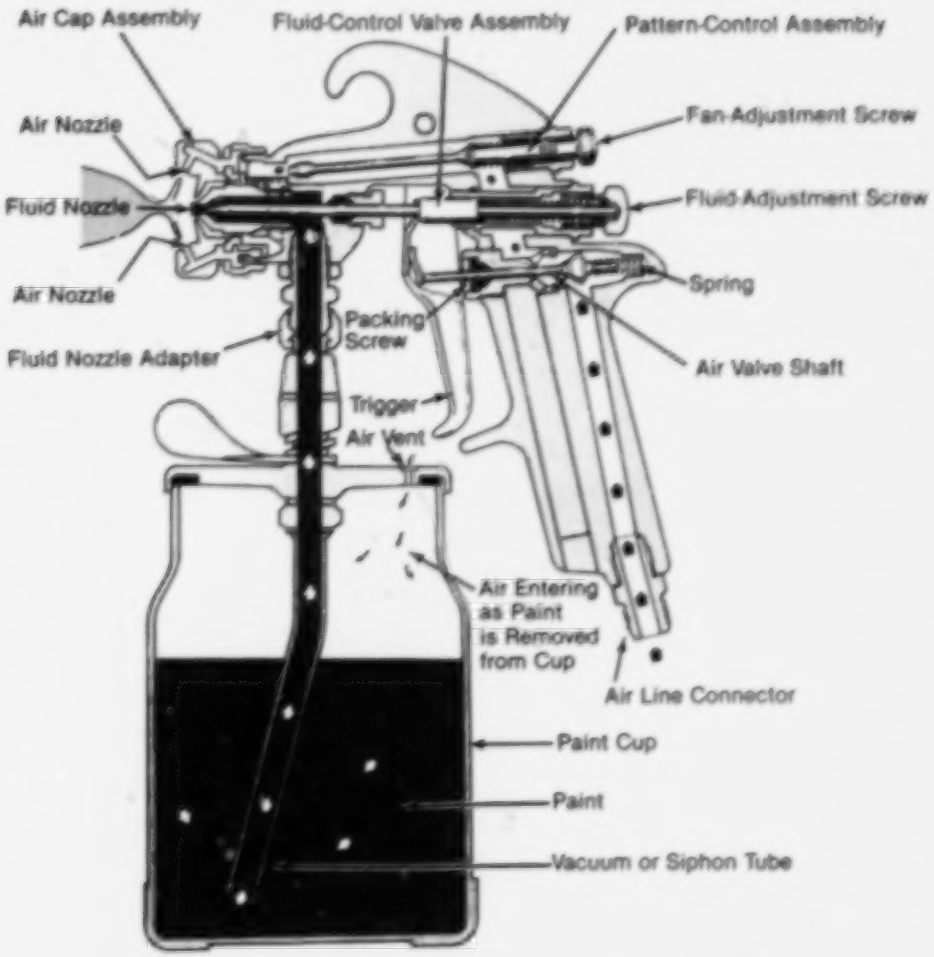
FIGURE 18



INFORMATION SHEET

III. Parts of a suction-feed spray gun (Figure 19)

FIGURE 19



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IV. General safety rules for paint equipment

A. Always read and follow instruction and caution labels on paints and other materials

(NOTE: Fumes from some materials—and the materials themselves—must not be inhaled, ingested [swallowed], or allowed to touch the skin.)

INFORMATION SHEET

B. Never use compressed air to dry your skin or to remove dust from skin or clothes

(NOTE: Compressed air is released with enough pressure to put out an eye.)

C. Use paint equipment and materials for their intended uses

D. Never place your bare hand over outlet nozzles of any spray equipment when spraying

E. Never make repairs or service equipment unless all electric or pneumatic power has been turned off

F. Do not try to connect extra electrical equipment to a circuit by using three-way plugs; this can overload the circuit and cause dangerous sparks

G. Always wear recommended protective clothing

(NOTE: If a respirator, rubber gloves, safety goggles, and protective clothing are recommended, put them on and wear them! Do not allow any unprotected person in the work area.)

V. Guidelines for maintaining an air compressor

A. Check oil every week; maintain oil at proper level

B. Change oil every two months

C. Check belt condition and tension every week; replace or adjust as necessary

D. Clean air-intake breather every week

E. Drain water from tank and check air safety valve every day

REFINISHING EQUIPMENT
UNIT I

ASSIGNMENT SHEET #1 — SOLVE PERCENTAGE PROBLEMS

NAME _____ SCORE _____

In the auto-body trade, you will frequently encounter percentages. Interest rates, pricing discounts, waste allowances, paint additives, and many other factors that affect the industry are stated as percentages. To make the most of your career in this field, you must understand what percentages mean and how they are used.

Use the following information and Table 1 to solve the percentage problems in Parts I through III of this assignment sheet.

A. Converting fractions to decimals and percentages

1. Fractions to decimals — Divide the numerator by the denominator

EXAMPLE: Convert $\frac{5}{8}$ to a decimal.

$\frac{5}{8}$ 5 Numerator, 8 Denominator

$$8\overline{)5.000} = 0.625$$

4 8
20
16
40
40
0

2. Fractions to percentages

(NOTE: Percent means that a number is a fraction of 100.)

a. Convert the fractions to decimals by dividing numerator by denominator

b. Move the decimal point in the answer two places to the right

c. Place the percent symbol after the number

EXAMPLE: Convert $\frac{7}{33}$ to a percentage.

$\frac{7}{33}$ 7 Numerator, 33 Denominator

$$33\overline{)7.0000} = 0.2121 = 21.21\%$$

66
40
33
70
66
40
33
7

ASSIGNMENT SHEET #1

B. Converting percentages to fractions and decimal numbers

1. Percentages to fractions

   a. Drop the percent symbol

   b. Place the number over 100

   c. Reduce to lowest terms if necessary

   EXAMPLE: Convert 38% to a fraction.

$$38\% = 38$$

$$= \frac{38}{100}$$

$$= \frac{19}{50}$$

2. Percentages to decimals

   a. Drop the percent symbol

   b. Move decimal point two places to left

   EXAMPLE: Convert 74% to a decimal.

$$74\% = 74$$

$$= 0.74$$

C. Solving percentage problems

(NOTE: Percentage problems may involve solving for the percent ["16 is what percent of 80?"], the part ["What number is 20% of 80?"], or the whole ["16 is 20% of what number?"].)

1. Write the unknown as "X"

   EXAMPLE: 16 is what percent of 80?

   16 is X percent of 80.

   (NOTE: The unknown may be the percent, the part, or the whole.)

ASSIGNMENT SHEET #1

2. Write the percent (known or unknown) as a fraction with a denominator of 100

   EXAMPLE: 16 is $\frac{X}{100}$ percent of 80.

3. Write the part and the whole as a fraction, writing the part as the numerator and the whole as the denominator

   EXAMPLE: $\frac{16}{80}$ $\begin{matrix}\text{Part}\\ \text{Whole}\end{matrix}$

4. Set up the equation by writing the two fractions with an equal sign between them

   EXAMPLE: $\frac{X}{100} = \frac{16}{80}$

5. Solve the equation by multiplying the numerator of each fraction by the denominator of the other

   (NOTE: This process is known as *cross multiplying*.)

   EXAMPLE: $\frac{X}{100} = \frac{16}{80}$

   $80X = 1600$

6. Divide each side of the equation by the multiplier of X

   EXAMPLE: $80X = 1600$

   $X = 20\%$

   16 is 20% of 80.

D. Solving ratio and proportion problems — To increase or decrease proportionally, multiply or divide each number in the ratio by the same number

   (NOTE: Ratio indicates parts of material per mix; proportion indicates that the ratio is the same but the quantity may differ.)

   EXAMPLE 1: You want to find half of the ratio 1:1:3.

   Divide each number in the ratio by 2 to get 0.5:0.5:1.5.

   EXAMPLE 2: You need three times the ratio 1:1:3.

   Multiply each number in the ratio by 3 to get 3:3:9.

ASSIGNMENT SHEET #1

TABLE 1

Parts paint	to	Parts thinner or reducer	=	Percentage of thinner or reducer in mixture
3		1		25%
2		1		50%
1 3/4		1		75%
1		1		100%
1		1 1/4		125%
1		1 1/2		150%
1		1 3/4		175%
1		2		200%

PART I

A. You are mixing enamel surfacer-primer and need a 150 % to 200 % mixture with 1 gallon of primer. How many gallons of reducer do you need?

Number of gallons = _____

B. How many gallons of lacquer paint could you thin 150 percent with 1 gallon of thinner?

Number of gallons = _____

C. How many gallons of enamel paint could be reduced 25 percent with 1 gallon of reducer?

Number of gallons = _____

D. What percentage of thinner are you using if you mix 1 3/4 parts reducer to 1 part paint?

Percentage = _____

E. How much reducer or thinner will you need to mix 1 1/2 gallons of paint 200 percent?

Number of gallons = _____

ASSIGNMENT SHEET #1

F. What percent is an equal amount of paint and reducer or thinner?

Percent = _____

G. How many gallons of reducer are needed to reduce 2 gallons of paint 50 percent?

Number of gallons = _____

H. What percentage is 1¾ parts paint to 1 part reducer or thinner?

Percentage = _____

PART II

A. What does it mean to say 100 percent of the work is completed? _____

_____

B. There are usually 100 tools in the tool room. Fourteen of them are missing. What percent of the tools are missing? _____

C. If 14 tools are missing in the above problem, how many are present? _____

What percent are present? _____

D. There are 100 sanding discs in a stack. Twenty-five discs are what percent of the discs in the stack? _____

Five discs are what percent of the discs in the stack? _____

ASSIGNMENT SHEET #1

E. There are 100 paint jobs scheduled for the month. Ninety-four have been completed. What percent of the jobs have been completed? _____

F. If 94 of the jobs in problem E have been completed, how many have not been?

_____

What percent have not been completed?_____

G. If 11 percent of the employees in the shop are absent, what percent are present? _____

H. If 6 percent of a paint is acrylic, what percent is not acrylic? _____

I. Gene McGill bought a new paint gun—regularly selling for $120—at a sale and saved 20 percent. How much did he save? _____

J. Betty Chester's paint shop had a 20 percent increase in business this year over last year. How much was the increase if her shop did $286,410 worth of business last year?

_____

K. Susan has three types of topcoats—acrylic lacquer, acrylic enamel, and polyurethane enamel. Eighty percent of her topcoats are acrylic lacquer, and 15 percent are polyurethane enamel. What percent are acrylic enamel? _____

ASSIGNMENT SHEET #1

L. The Smiths spent 22 percent of their income for their business: 17 percent for tools, 15 percent for work clothes, and 8 percent for entertainment. What percent was left for other things? _____

M. Chester has finished 75 percent of the job he is doing. What percent does he still have to do? _____

N. Betty has completed 40 percent of her training. What percent does she still have to do?

_____

O. If you were told to complete 93 percent of the work, what percent would be left? _____

P. There are 20 technicians in the shop. Sixty percent of the technicians are over twenty-two years old. How many technicians are over twenty-two years old? _____

Q. One day 5 percent of the 20 technicians in Mr. Moore's group made perfect time completing a job. How many technicians made perfect time? _____

R. Tony Martinez bought a new sander—regularly selling for $120—at a sale and saved 12 percent. How much money did he save? _____

S. The number of technicians at the state meeting this week was 75 percent of what it was last week. Last week there were 800 technicians at the meeting. How many technicians were at the meeting this week? _____

ASSIGNMENT SHEET #1

PART III

Solve each of the following percentage problems.

A. 3% of 72 is what number? _____

B. 5% of 18 is what number? _____

C. What number is $33\frac{1}{3}\%$ of 96? _____

D. 40% of 125 is what number? _____

E. 68% of 63.5 is what number? _____

F. What number is $12\frac{1}{2}\%$ of 140.8? _____

G. What number is 1% of 103? _____

H. What number is $37\frac{1}{2}\%$ of 152? _____

I. 50% of 32.8 is what number? _____

J. 7% of 163 is what number? _____

REFINISHING EQUIPMENT
UNIT I

ASSIGNMENT SHEET #2 — SOLVE BASIC RATIO AND PROPORTION PROBLEMS

NAME _____ SCORE _____

The auto-body trade uses ratios and proportions in mixing paints. The technician will be required to calculate some ratios and proportions, and may be required to apply others.

Solve the following ratio and proportion problems.

A. Convert the ratio 0.25:0.25:1 to the smallest proportion possible containing whole numbers.

Proportion = _____

B. What would be the proportion if a 1:2:12 mix were cut in half?

Proportion = _____

C. What would be the proportion if the ratio 1:1:3 were tripled?

Proportion = _____

D. You are asked to mix a solution of paint using a 1:1:6 ratio, but you will need six times this amount. What will be the proportion of material needed?

Proportion = _____

E. A mixture of 1 part reducer, 1 part pigment, and 3 parts enamel is needed to make 25 pints of a certain tint of paint. How many pints of each are needed?

Pints reducer = _____

Pints pigment = _____

Pints enamel = _____

REFINISHING EQUIPMENT
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

PART I

A. 1¼ gallons
B. None
C. 3 gallons
D. 175 percent
E. 3 gallons
F. 100 percent
G. 1 gallon
H. 75 percent

PART II

A. All work is completed
B. 14%
C. 86, 86%
D. 25%, 5%
E. 94%
F. 6, 6%
G. 89%
H. 94%
I. $24.00
J. $9807.24
K. 5%
L. 38%
M. 25%
N. 60%
O. 7%
P. 12
Q. 1
R. $14.40
S. 600

PART III

A. 2.16
B. 0.9
C. 32
D. 50
E. 43.18
F. 17.6
G. 1.03
H. 57
I. 16.4
J. 11.41

Assignment Sheet #2

A. 1:1:4
B. 0.5:1:6
C. 3:3:9
D. 6:6:36
E. 5 pints reducer
   5 pints pigment
   15 pints enamel

REFINISHING EQUIPMENT
UNIT I

JOB SHEET #1 — FILL A SUCTION-FEED SPRAY GUN AND SET CORRECT PRESSURE, FAN PATTERN, AND FLUID FLOW

I. Equipment and materials

A. Suction-feed spray gun

B. Air hose

C. Paint paddle

D. Viscosity cup

E. Measuring cup

F. Watch with second hand, or stopwatch

G. Paint

H. Recommended thinner or reducer

I. Paint strainer

J. Test panel

K. Ruler

L. Respirator

M. Rubber gloves

N. Eye protection

II. Procedure

A. Read instruction and caution labels on paint can and thinner or reducer containers

CAUTION

Thinners and reducers are highly flammable and some paint fumes are toxic. Read label instructions and cautions, wear the proper respirator, and take all precautions to prevent bodily harm.

B. Open can of paint and stir with paint paddle, making sure to get down into the corners of the container to stir up any pigment that has settled there

(NOTE: The paint may be agitated rather than stirred if a paint shaker is available.)

C. Add recommended percentage of thinner or reducer

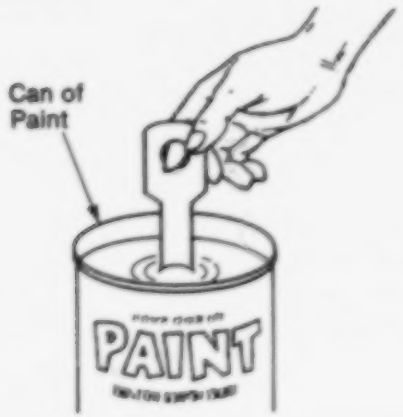
D. Thoroughly stir paint

(NOTE: Do not agitate paint to which thinner or reducer has been added.)

E. Test paint for viscosity

1. Dip viscosity cup into paint until it is full (Figure 20)

FIGURE 20



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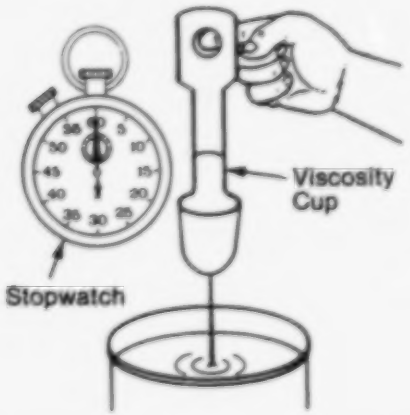
2. Raise full cup out of paint; as it clears the surface, begin timing the flow from small hole in bottom of cup (Figure 21)

FIGURE 21



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JOB SHEET #1

3. Stop watch when stream of paint first breaks (Figure 22), and not when it stops completely

FIGURE 22

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4. Compare reading with that on paint can or that shown in Table 1 below

TABLE 1: Paint Viscosity

Kind of paint	Recommended viscosity (seconds)
Acrylic lacquer	18 to 22
Acrylic enamel	18 to 21
Urethane enamel	18 to 22
Flexible finish	16 to 20

F. Add additional thinner or reducer if necessary

G. Thoroughly stir paint again

(NOTE: Do not agitate paint to which thinner or reducer has been added.)

H. Place strainer in spray gun paint cup or on strainer stand over cup as illustrated in Figure 23 or Figure 24

I. Pour paint through strainer to remove impurities (Figures 23 and 24)

FIGURE 23

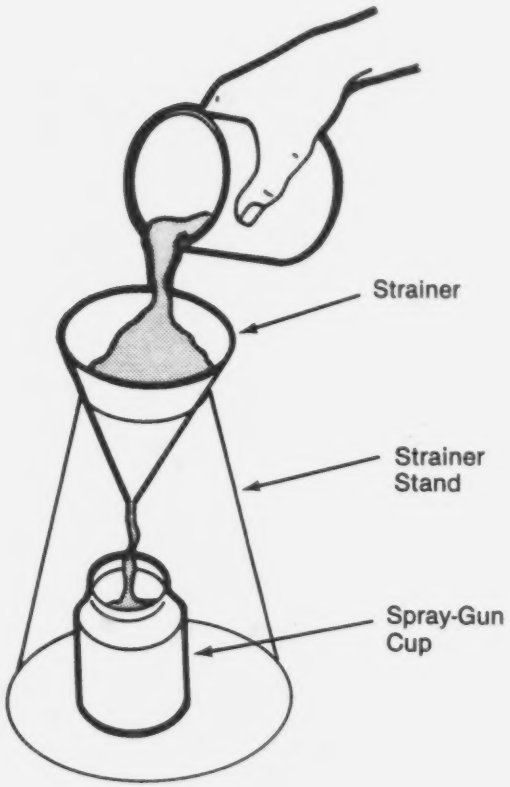
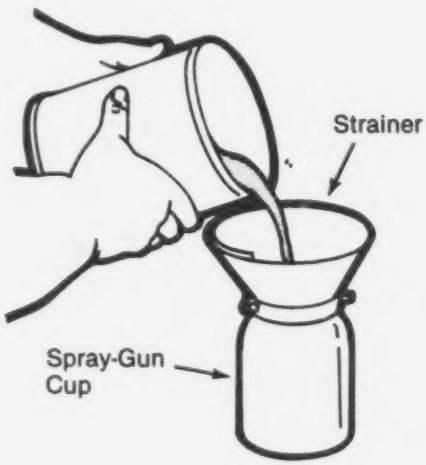


FIGURE 24



J. Attach paint cup to spray gun

K. Attach air hose to gun

L. Open air-outlet valve leading to air hose if necessary

M. Set correct air pressure

(NOTE: The recommended air pressure varies with the kind of paint and the type of repair. Usually the air pressure recommended for the paint being sprayed is listed on the paint can.)

1. Read label on paint can or use Table 2 on the next page to determine at-the-gun pressure recommended for material being sprayed

JOB SHEET #1

TABLE 2: Typical Spray Pressures Recommended *at the Gun*

Kind of paint	Recommended air pressure at the gun (psi)	
	Spot repair	Panel/overall
Acrylic lacquer	20 to 35	40 to 45
Acrylic enamel	30 to 40	50 to 65
Urethane enamel (nonmetallic)	50	50
Urethane enamel (metallic)	65	65

2. Adjust air pressure at transformer regulator gauge accordingly

3. Use gauge at gun to measure exact air pressure *at the gun*

   (NOTE: Some spray guns have an air-pressure indicator, similar to a tire pressure gauge, built into the handle. These devices, called *air controllers*, provide the most accurate method of checking air pressure at the gun.)

4. If no gauge is available at the gun, set air pressure on transformer regulator gauge according to Table 3 below

   (NOTE: Hose diameters are based on their inside dimensions.)

TABLE 3: Typical Spray Pressures Recommended at Transformer

	Pressure reading at the transformer (lb)	Pressure at the gun for various hose lengths					
		5 ft	10 ft	15 ft	20 ft	25 ft	50 ft
1/4-Inch Hose	30	26	24	23	22	21	9
	40	34	32	31	29	27	16
	50	43	40	38	36	34	22
	60	51	48	46	43	41	29
	70	59	56	53	51	48	36
	80	68	64	61	58	55	43
	90	76	71	68	65	61	51
5/16-Inch Hose	30	29	28 1/2	28	27 1/2	27	23
	40	38	37	37	37	36	32
	50	47	48	46	46	45	40
	60	57	56	55	55	54	49
	70	66	65	64	63	63	57
	80	75	74	73	72	71	66
	90	84	83	82	81	80	74

5. Squeeze trigger at gun

   (NOTE: When air pressure is set at the transformer, as soon as the gun is triggered, the pressure at the gun drops due to friction of the compressed air as it passes through the transformer, hose, and hose couplings.)

6. Adjust pressure at regulator until pressure at gun is accurately set

   (NOTE: Additional adjustment may be necessary for exact color match.)

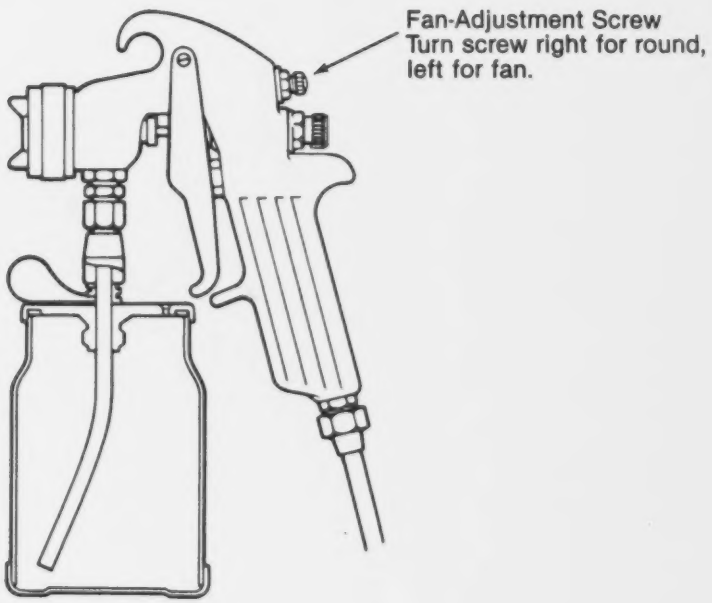
N. Set fan adjustment (Figure 25)

   (NOTE: The air screw should be wide open for complete panels and less open for spot repairs.)

   1. For initial fan pattern of maximum size, turn fan-adjustment screw counterclockwise until it stops and is fully open

   2. For round pattern, turn fan-adjustment screw clockwise

FIGURE 25



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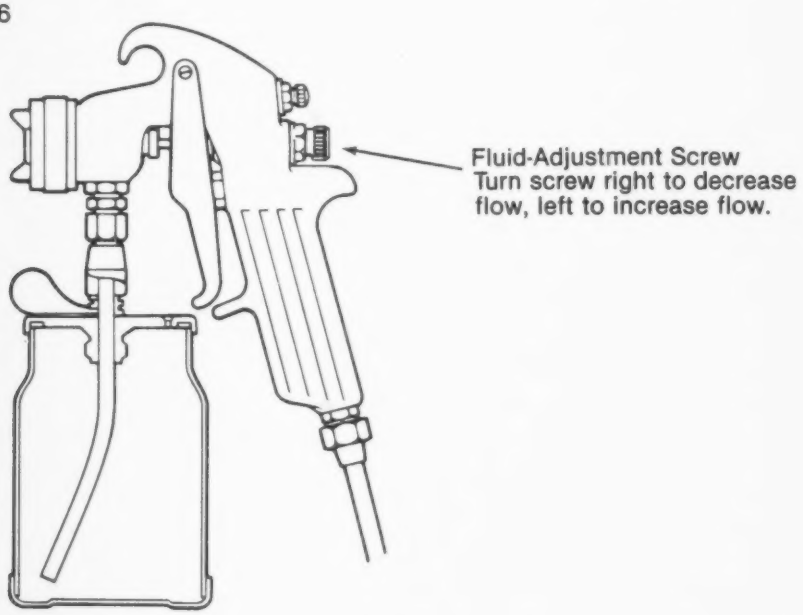
JOB SHEET #1

M. Set initial fluid adjustment for maximum size by backing out fluid-adjustment screw until it is wide open and first thread on screw is visible (Figure 26)

FIGURE 26



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O. Test adjustment of spray gun by holding gun upright about 8 inches from test panel and pulling trigger

P. Examine size and shape of pattern; adjust gun as necessary until sprayed area is about 8 to 10 inches high and about 2 to 3 inches wide

Q. Examine texture of spray pattern; if it is rough, dry, or thin, adjust air-pressure screw or fluid-adjustment screw until desired texture is obtained

R. Clean paint gun, following procedure outlined in Job Sheet #2

S. Clean work area return equipment and materials to proper storage

REFINISHING EQUIPMENT
UNIT I

JOB SHEET #2 — CLEAN A SUCTION-FEED PAINT GUN

I. Equipment and materials

A. Suction-feed paint gun

B. Lacquer thinner or gun-and-equipment cleaner

C. Clean shop cloths

D. Round wooden toothpick

E. Lubricant recommended by spray-gun manufacturer

F. Petroleum jelly

G. Eye protection and rubber gloves

H. Respirator

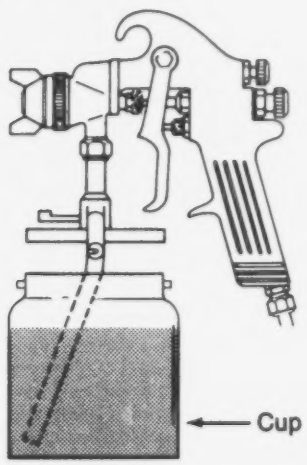
II. Procedure

(NOTE: The spray gun is always cleaned immediately after use to prevent the paint from drying and clogging the passages.)

A. Put on eye protection, rubber gloves, and proper respirator

B. Loosen cup from gun and raise gun, holding end of fluid line over cup (Figure 27)

FIGURE 27



From *Automotive Body Repair and Refinishing*, copyright 1986. Used with permission of Binks Manufacturing Company.

JOB SHEET #2

C. Unscrew air cap two or three turns

D. Hold cloth over air cap and pull trigger on gun to force any paint in gun back into cup (Figure 28)

FIGURE 28

From *Automotive Body Repair and Refinishing*, copyright 1986. Used with permission of McGraw-Hill Book Company.

E. Remove cup from gun and pour its contents into waste paint can

F. Rinse cup with lacquer thinner or gun cleaner, discarding solvent in proper container after cup is clean

CAUTION

Thinners are highly flammable. Read label instructions and cautions and take all precautions to prevent bodily harm when using thinners to paint or clean.

G. Refill paint cup about one-third full of thinner or gun cleaner

H. Reinstall paint cup on gun, and spray solvent to flush paint from gun (Figure 29)

FIGURE 29

From *Automotive Body Repair and Refinishing*, copyright 1986. Adapted with permission of McGraw-Hill Book Company.

JOB SHEET #2

I. Hold clean shop cloth over air cap to force thinner back into cup

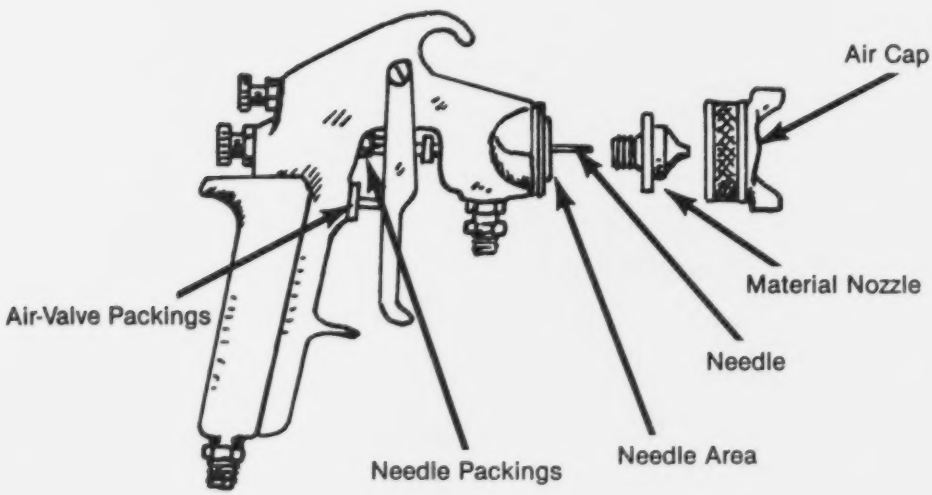
J. Release cloth and allow thinner to spray through gun again

K. Repeat this process, forcing solvent back and forth several times to thoroughly clean gun

L. Discard contaminated solvent, and fill cup about one-third full with clean solvent

M. Remove air cap from gun and soak in paint cup solvent (Figure 30)

FIGURE 30



N. Loosen material adjustment screw and remove needle

O. Place needle in solvent cup

P. Use a toothpick to clean out material nozzle and any clogged holes in air cap (Figures 31 and 32)

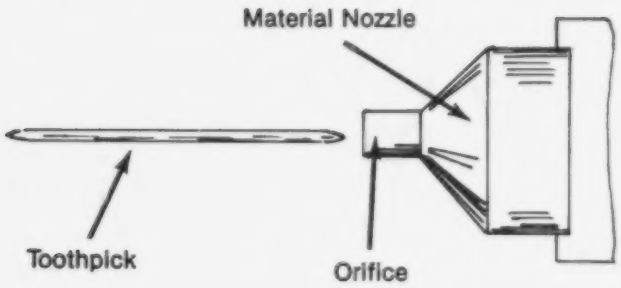
CAUTION

Never use a metal object to clean air cap holes. Metal objects can enlarge the holes and ruin the spray pattern.

JOB SHEET #2

FIGURE 31

FIGURE 32



Q. Dry off air cap, material nozzle, and needle with compressed air; reinstall

R. Pour contaminated solvent out of cup into proper work container; fill cup one-third full with clean solvent, and install cup on paint gun

S. Spray thinner through gun, forcing it back and forth as in steps I through K

T. After gun and nozzle are clean, dicard contaminated solvent in proper container

U. Lubricate gun with recommended lubricant

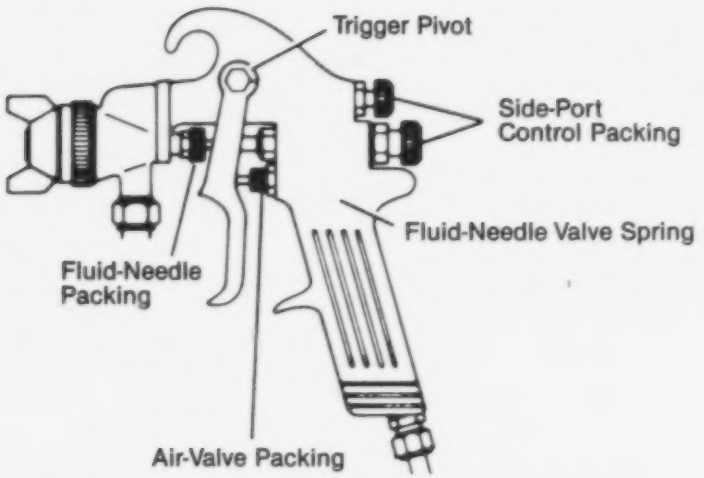
CAUTION

Never lubricate any part of the spray gun with a lubricant containing silicone. If silicone gets into the spray gun or hose, it cannot be completely flushed out.

1. Use recommended lubricant on fluid-needle packing, air-valve packing, side-port control packing, and trigger pivot points (Figure 33)

JOB SHEET #2

FIGURE 33



From *Air Spray Manual*, copyright 1985. Used with permission of Binks Manufacturing Company.

2. Coat needle-valve spring with petroleum jelly

V. Fill spray gun paint cup with about 1 inch of thinner, and reinstall cup on gun for storage

W. Clean work area and return equipment and materials to proper storage

REFINISHING EQUIPMENT
UNIT I

JOB SHEET #3 — CLEAN AND SERVICE PAINT BOOTH FILTERS

I. Equipment and materials

A. Clean shop towels

B. Glass cleaner

C. Thinner

D. Air gun

E. Broom and dustpan

F. Screwdriver

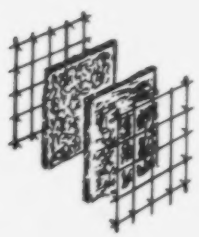
G. Replacement fluorescent tubes

H. ½-inch foam strips for sealing replacement glass and filters

I. Replacement paint arrestors

(NOTE: Paint arrestors are special small filters placed in the outlet end of the air system to catch overspray and prevent it from collecting in the fan. See Figure 34.)

FIGURE 34



II. Procedure

A. Clean light system

(NOTE: The light system should be cleaned three or four times a year.)

1. Remove outside cover from fluorescent lights

2. Remove fluorescent tubes and clean thoroughly with glass cleaner

3. Wipe off each tube with clean cloth before reinstalling it

4. Replace tubes as necessary, cleaning and wiping each replacement tube before installation

5. Clean outside of light cover with glass cleaner

6. Clean inside of glass cover with thinner to remove any overspray from the inside

7. After overspray has been removed, finish the job by cleaning with glass cleaner

8. Reinstall light cover; resealing with new foam strip if necessary

B. Change paint arrestors

(NOTE: Check paint arrestors often and change at least once a month.)

1. Read booth draft gauge and compare to manufacturer's specifications; if air flow is too low, the arrestors must be changed

2. If standard, two-pad, treated-type arrestor is used, remove front pad when it gets clogged and discard; move back pad to front and install new pad in back

3. With fiberglass-type arrestor that uses only one pad, remove and discard the clogged pad and replace with a new pad, following manufacturer's instructions

4. Blow down arrestors and area with blow gun

5. Sweep area clean and discard sweepings

C. Change paint booth filters

(NOTE: Filters should be changed when white side shows large areas of dirt.)

1. Remove all filters and clean the area completely

2. Check filter access doors to make sure that they are sealing properly; if seal is poor, reseal with new foam strip(s)

   (NOTE: A good seal is necessary to increase air flow.)

3. Install new filters according to manufacturer's instructions, with colored, tacky layer facing inside of booth

   (NOTE: Dirty air should enter the white side of the filters.)

JOB SHEET #3

D. Shut up paint booth

E. Turn on paint booth exhaust system

F. Starting at blowers, use air gun to blow clean all areas of paint booth so that any remaining fine dust will be blown out through paint arrestors in exhaust system

G. Clean work area and return equipment and materials to proper storage

REFINISHING EQUIPMENT
UNIT I

JOB SHEET #4 — DRAIN MOISTURE FROM A SEPARATOR-REGULATOR

I. Equipment and materials

A. Separator-regulator

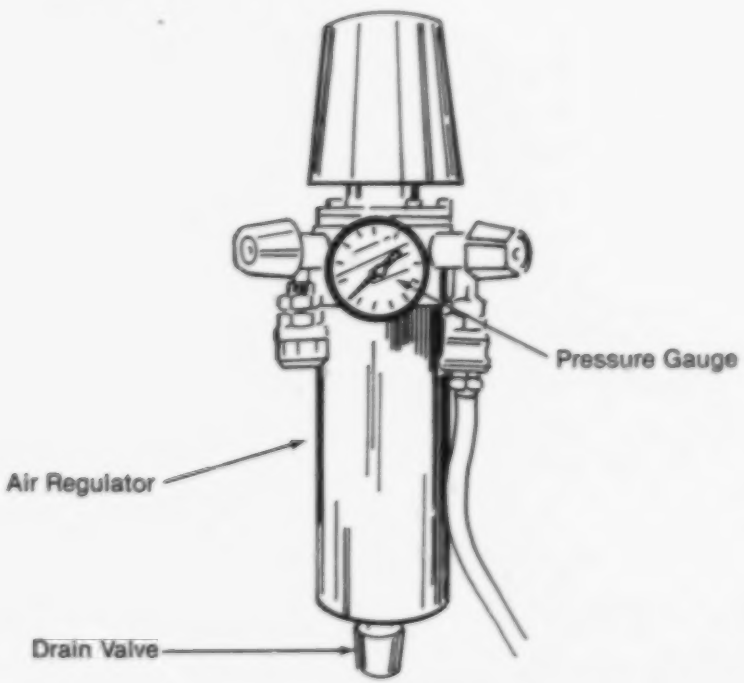
B. Eye protection

II. Procedure

A. Put on eye protection

B. Locate drain valve on separator-regulator (Figure 35)

FIGURE 35



C. Stand to one side and release drain valve to allow water to run out under pressure

CAUTION

The separator-regulator system is under high air pressure. Use care when draining it, and avoid getting foreign matter in eyes or on skin.

JOB SHEET #4

D. Drain until dry and then finger-tighten drain valve

(NOTE: The regulator should be drained every morning. In systems where large volumes of air are used, the regulator should be drained several times a day.)

E. Clean work area and return equipment and materials to proper storage

REFINISHING EQUIPMENT
UNIT I

JOB SHEET #5 — DRAIN AND SERVICE AN AIR COMPRESSOR

I. Equipment and materials

A. Air compressor and service manual

B. Lubricating oil

C. Eye protection

D. Drain pan

E. Replacement belts

II. Procedure

(NOTE: Water should be drained from the compressor every day.)

A. Put on eye protection

B. Turn off electric power to compressor

C. Drain air from compressor, leaving air valve nearest compressor open

D. Locate water drain and open

1. If system has a high-side drain valve with an internal siphon tube, air pressure will have to remain in the tank to drain properly

2. If valve is in the bottom, let all air pressure out of tank to prevent air locks that will not allow the tank to drain properly

E. Locate air-intake filter and check to see if it is dirty

1. If it is a dry filter and is dirty, replace it

2. If it is an oil-bath filter and is dirty, clean it and refill with recommended oil

(NOTE: Use only the recommended oil to prevent the oil from being sucked into the compressor.)

F. Locate pump crankcase oil drain plug and remove

1. Drain oil into pan

2. Install plug and tighten

3. Fill compressor crankcase, following directions provided by manufacturer as to type of oil, weight, and amount

G. Check belts

1. Replace belts if worn

(NOTE: Belts come in matched sets, thus requiring the replacement of both belts, even if only one is worn.)

2. Tighten belts if loose, tightening to manufacturer's specifications to prevent damage to compressor and motor bearings

H. Close all valves and check air, water, and oil drain plugs

I. Turn on electric power to compressor

J. Clean work area and return equipment and materials to proper storage

REFINISHING EQUIPMENT
UNIT I

TEST

NAME _____ SCORE _____

1. Match to their correct definitions terms associated with refinishing equipment. Write the correct numbers in the blanks.

_____a. Process of changing liquid into fine droplets

_____b. To stir or shake up, as with paint

_____c. To use a tube to carry liquid out of a container, using only force of atmospheric pressure on surface of liquid

_____d. To move in a circular pattern

_____e. Abrasive paste that smooths paint film

_____f. Coloring matter

_____g. Resistance to flow; thickness of a liquid

_____h. Air-pressure gauge with built-in regulator that can be adjusted to set desired pressure in paint gun

_____i. Moving back and forth

_____j. Cloth saturated with diluted varnish to make it sticky so that it will pick up dust and dirt particles

_____k. Quality of wax that causes it to reject water

1. Viscosity
2. Rubbing compound
3. Siphon
4. Pigment
5. Orbital
6. Hydrophobic
7. Air controller
8. Atomization
9. Tack rag
10. Agitate
11. Oscillating

TEST

2. Identify and describe the following auto-body refinishing equipment. Write the correct names and descriptions in the blanks.

Pressure-feed spray gun
Suction-feed spray gun
Blow gun
Air brush
Air regulator with water trap
Air compressor
Paint paddle
Paint strainer
Viscosity cup
Orbital sander
Oscillating sander
Buffer
Apron taper
Sanding block
Paint booth
Panel drying system
Spot repair drying system
Draft gauge

a.

Name: _____

Description: _____

_____

b.

Name: _____

Description: _____

_____

TEST

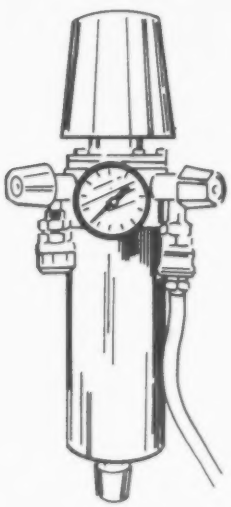
c.

Name: _____

Description: _____

_____

d.



Name: _____

Description: _____

_____

TEST

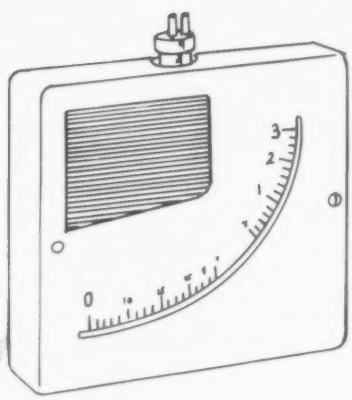
e.

Name: _____

Description: _____

_____

f.



Name: _____

Description: _____

_____

TEST

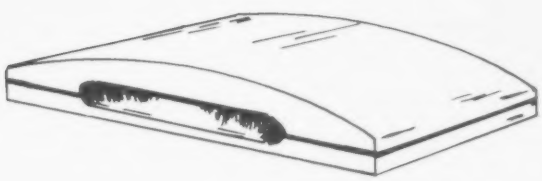
g.

Name: _____

Description: _____

_____

h.



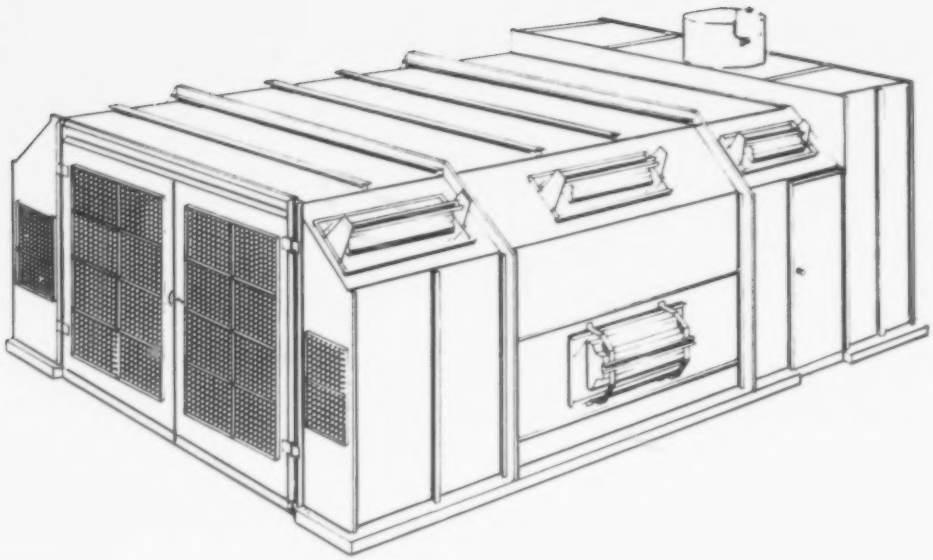
Name: _____

Description: _____

_____

TEST

i.



Name: _____

Description: _____

_____

j.

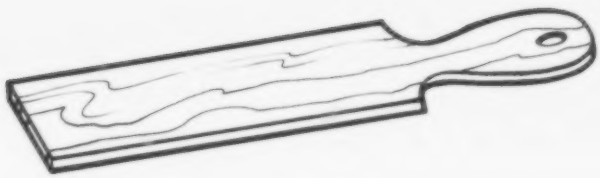
Name: _____

Description: _____

_____

TEST

k.



Name: _____

Description: _____

_____

l.

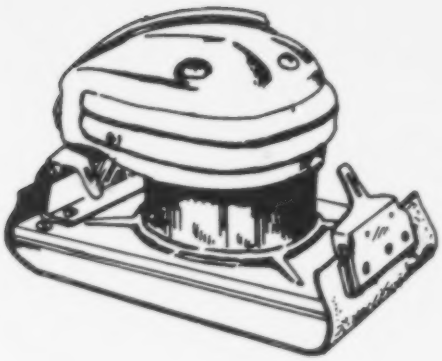
Name: _____

Description: _____

_____

TEST

m.



Name: _____

Description: _____

_____

n.

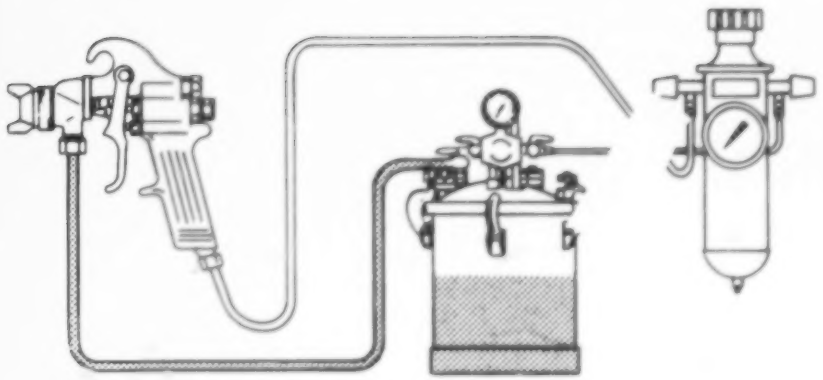
Name: _____

Description: _____

_____

TEST

o.

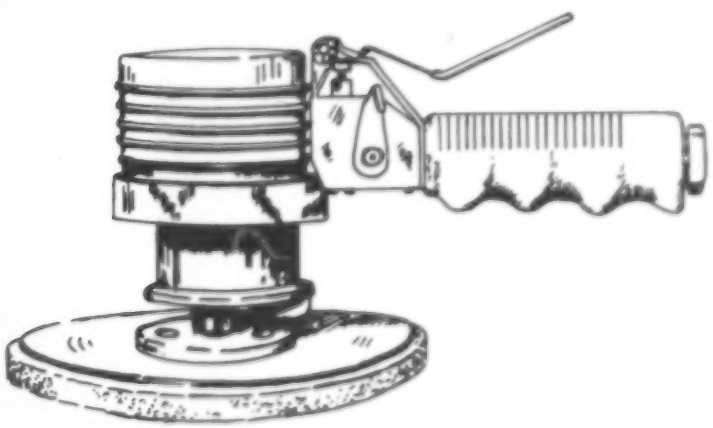


Name: _____

Description: _____

_____

p.



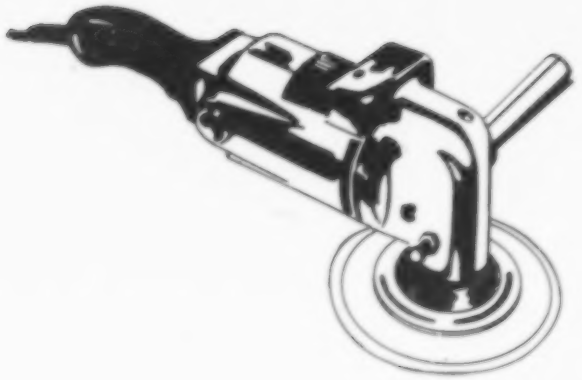
Name: _____

Description: _____

_____

TEST

q.



Name: _____

Description: _____

_____

r.

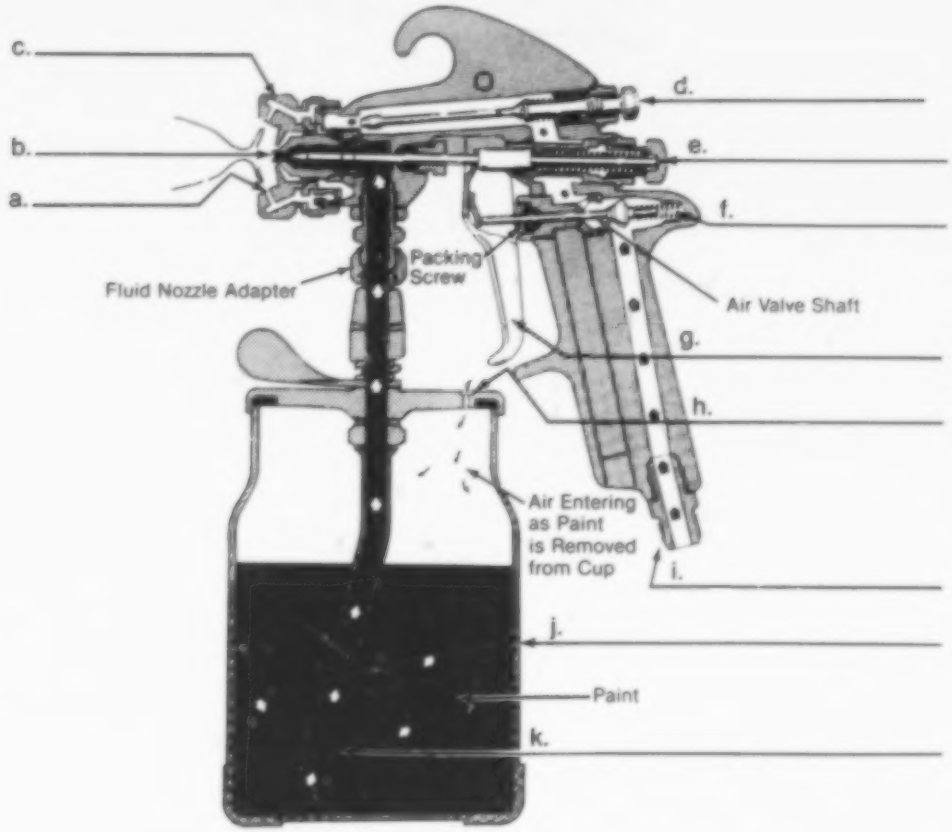
Name: _____

Description: _____

_____

TEST

3. Label the parts of the suction-feed spray gun illustrated below.



4. State four general safety rules for refinishing equipment.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

TEST

5. Select from the following list guidelines for maintaining an air compressor. Write an "X" in the blank before each correct answer.

_____a. Check oil every twenty-four hours; maintain oil at proper level

_____b. Check oil every week; maintain oil at least one-third level

_____c. Check oil every week; maintain oil at proper level

_____d. Change oil every two months

_____e. Change oil every two weeks

_____f. Change oil every two days

_____g. Check belt condition and tension every day; replace or adjust as necessary

_____h. Check belt condition and tension every week; replace or adjust as necessary

_____i. Check belt condition and tension every two months; replace or adjust as necessary

_____j. Clean air-intake breather every week

_____k. Clean air-intake breather every day

_____l. Clean air-intake breather after each use

_____m. Drain water from tank and check air safety valve every day

_____n. Drain water from tank and check air safety valve every week

_____o. Drain water from tank and check air safety valve every month

(NOTE: Test item 6 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

6. Demonstrate the ability to

a. Fill a suction-feed spray gun and set correct pressure, fan pattern, and fluid flow.

b. Clean a suction-feed paint gun.

c. Clean and service paint booth filters.

d. Drain moisture from a separator-regulator.

e. Drain and servive an air compressor.

REFINISHING EQUIPMENT
UNIT I

ANSWERS TO TEST

1.
a.	8	g.	1
b.	10	h.	7
c.	3	i.	11
d.	5	j.	9
e.	2	k.	6
f.	4		

2. a. Blow gun
Small compressed air nozzle used with air compressor to blow dust and dirt from cracks and surface of vehicle

b. Air brush
Small paint atomizer designed for small, intricate jobs and for touch-up work

c. Paint strainer
Funnel-shaped cone used to strain out any dirt, lumps, or scum in paint as it is poured into spray gun; may be made of mesh, fiber, wire, or disposable filter paper

d. Air regulator with water trap
Used to supply spray equipment with clean, dry air and to regulate air pressure; separates oil and water from air

e. Viscosity cup
Special measuring device that allows the technician to determine the thickness or flow of paint to compare to specifications

f. Draft gauge
Used to measure flow of air in paint booth

g. Apron taper
Machine designed to hold masking paper and tape; as paper is pulled off roll, tape is dispensed to edge of paper, making an apron, or overlap

h. Sanding block
Block to which abrasive is attached to evenly distribute pressure when hand sanding

i. Paint booth
Totally enclosed, dirt-free and dust free environment in which to paint vehicles

j. Spot repair drying system
Used to force heat and hot, dry air over small area of vehicle

k. Paint paddle
Metal, wood, or plastic implement used to stir paint to evenly mix ingredients

ANSWERS TO TEST

l. Air compressor
Source of compressed air for spray guns and brushes

m. Orbital sander
Used to smooth metal and to sand and featheredge paint

n. Suction-feed spray gun
Paint atomizer in which compressed air flows through a small opening around fluid tip in gun cap, creating a slight vacuum and allowing atmospheric pressure to push paint up and out

o. Pressure-feed spray system
Paint atomizer in which compressed air forces paint from a pressure tank, through a tube to the gun, and out the gun tip; used on large jobs such as trucks and buses

p. Oscillating sander
Used to remove paint

q. Buffer
Power tool with felt wheel used to apply abrasive compounds

r. Panel drying system
Used to force heat and hot, dry air over vehicle panel

3. a. Air nozzle
b. Fluid nozzle
c. Air cap assembly
d. Fan-adjustment screw
e. Fluid-adjustment screw
f. Spring
g. Trigger
h. Air vent in cover
i. Air line connector
j. Paint cup
k. Vacuum or siphon tube

4. Answer should include any four of the following

a. Always read and follow instruction and caution labels on paints and other materials
b. Never use compressed air to dry your skin or to remove dust from skin or clothes
c. Use paint equipment and materials only for their intended uses
d. Never place your hand over outlet nozzles of any spray equipment when spraying
e. Never make repairs or service equipment unless all electric or pneumatic power has been turned off
f. Do not try to connect extra electrical equipment to a circuit by using three-way plugs; this can overload the circuit and cause dangerous sparks
g. Always wear recommended protective clothing

ANSWERS TO TEST

5. c, d, h, j, m

6. Performance skills evaluated to the satisfaction of the instructor

PREPARING SURFACES FOR PAINT
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to sand or strip painted surfaces for spot repair, panel repair, or complete repainting of a vehicle, and should be able to prepare the vehicle surface for paint. The student will show this ability by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with preparing surfaces for paint.
2. List methods of removing old paint.
3. Select from a list the purposes of sanding.
4. State the purpose of featheredging.
5. Compare characteristics of wet sanding and dry sanding.
6. Select from a list wet-sanding applications.
7. List guidelines for hand sanding.
8. Demonstrate the ability to
    a. Featheredge broken paint.
    b. Wet-sand for a complete paint job.
    c. Dry-sand for a complete paint job.
    d. Scuff-sand a surface.
    e. Remove paint with chemical stripper.
    f. Prepare an unpainted aluminum panel for refinishing.
    g. Prepare an unpainted galvanized panel for refinishing.

PREPARING SURFACES FOR PAINT
UNIT II

SUGGESTED ACTIVITIES

I. Unit references

A. Objective sheet

B. Suggested activities

C. Transparency masters

1. TM #1 — Back-Sanding

2. TM #2 — Featheredge

D. Information sheet

E. Job sheets

1. Job Sheet #1 — Featheredge Broken Paint

2. Job Sheet #2 — Wet-Sand for a Complete Paint Job

3. Job Sheet #3 — Dry-Sand for a Complete Paint Job

4. Job Sheet #4 — Scuff-Sand a Surface

5. Job Sheet #5 — Remove Paint with Chemical Stripper

6. Job Sheet #6 — Prepare an Unpainted Aluminum Panel for Refinishing

7. Job Sheet #7 — Prepare an Unpainted Galvanized Panel for Refinishing

F. Test

G. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Order or obtain materials to supplement unit.

1. Equipment and materials for job sheet procedures

2. Audiovisual aids

(NOTE: The following live-action VHS videotapes illustrate step-by-step concepts to help the student gain full mastery of the subject. Produced by District One Technical Institute of Eau Claire, Wisconsin, the tapes are available from Teaching Aids, Incorporated, Post Office Box 1798, Costa Mesa, California 92628-0798.)

a. *Auto Body Series II: Choosing Proper Abrasives,* 11 minutes

b. *Auto Body Series II: Sanding Techniques,* 13.30 minutes

c. *Auto Body Series II: Priming and Block Sanding,* 20 minutes

d. *Auto Body Series II: Wax and Grease Silicon Removal,* 7.30 minutes

e. *Auto Body Series II: Metal Conditioning,* 7 minutes

3. VHS recorder/player

4. Samples of various types and grits of sandpaper

5. Competency profiles and transparencies

(NOTE: Competency profiles and transparencies for this manual are available from the State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

C. Provide students with unit.

D. Introduce unit.

SUGGESTIONS:

- Discuss unit and specific objectives, pointing out how mastery of the specific objectives leads to accomplishment of the unit objective.
- Review *Automotive Body Repairer*, Unit III, Section B on metal finishing.
- Review rules for safe use of grinders and sanders. Stress the need for particle mask or respirator.
- Point out that all of the solvents, primers, conditioners, and thinners used in vehicle preparation are potentially hazardous, and that most of them are highly flammable. Have students read the labels from a variety of products. Discuss with class.
- Stress that in order to avoid problems with the finish paint coat, care must be taken during this stage of the vehicle refinishing process.

E. Discuss information and job sheets.

1. Use Information Sheet, Section I to introduce students to terms associated with preparing surfaces for paint.

2. Use Information Sheet, Section II to explain the three methods that can be used to remove old, unwanted paint.

3. Use Information Sheet, Sections III and IV to discuss the purposes of sanding and featheredging.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Use Transparencies #1 and #2 to illustrate your discussion.
- Demonstrate each of these processes.
- Show appropriate audiovisuals.

4. Use Information Sheet, Sections V and VI to discuss wet and dry sanding techniques and instances in which wet sanding is used.

   SUGGESTIONS:

   - Demonstrate each of the sanding techniques
   - Show students appropriate audiovisuals.
   - Allow students to practice each of the sanding techniques on scrap metal.

5. Use Information Sheet, Section VII to discuss guidelines for hand sanding.

   SUGGESTIONS:

   - Show appropriate audiovisuals.
   - Explain the consequences of improperly preparing a vehicle for sanding.
   - Discuss and demonstrate Job Sheets #1 through #7. Assign completion dates, and have the students complete the job sheets under your supervision.

F. Review unit and give test.

G. Critique test and discuss in class.

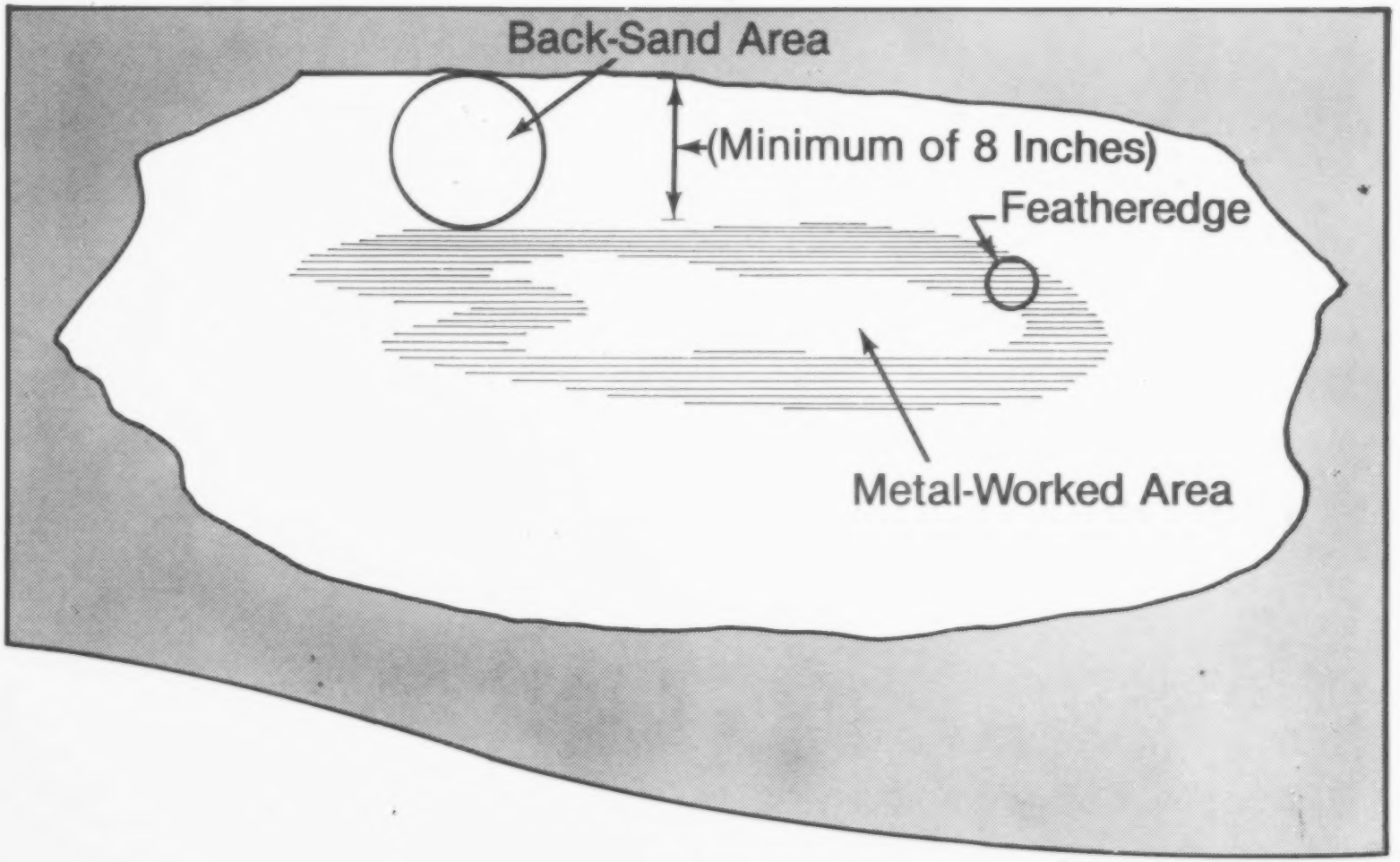
H. Complete appropriate section of competency profiles.

III. Unit references

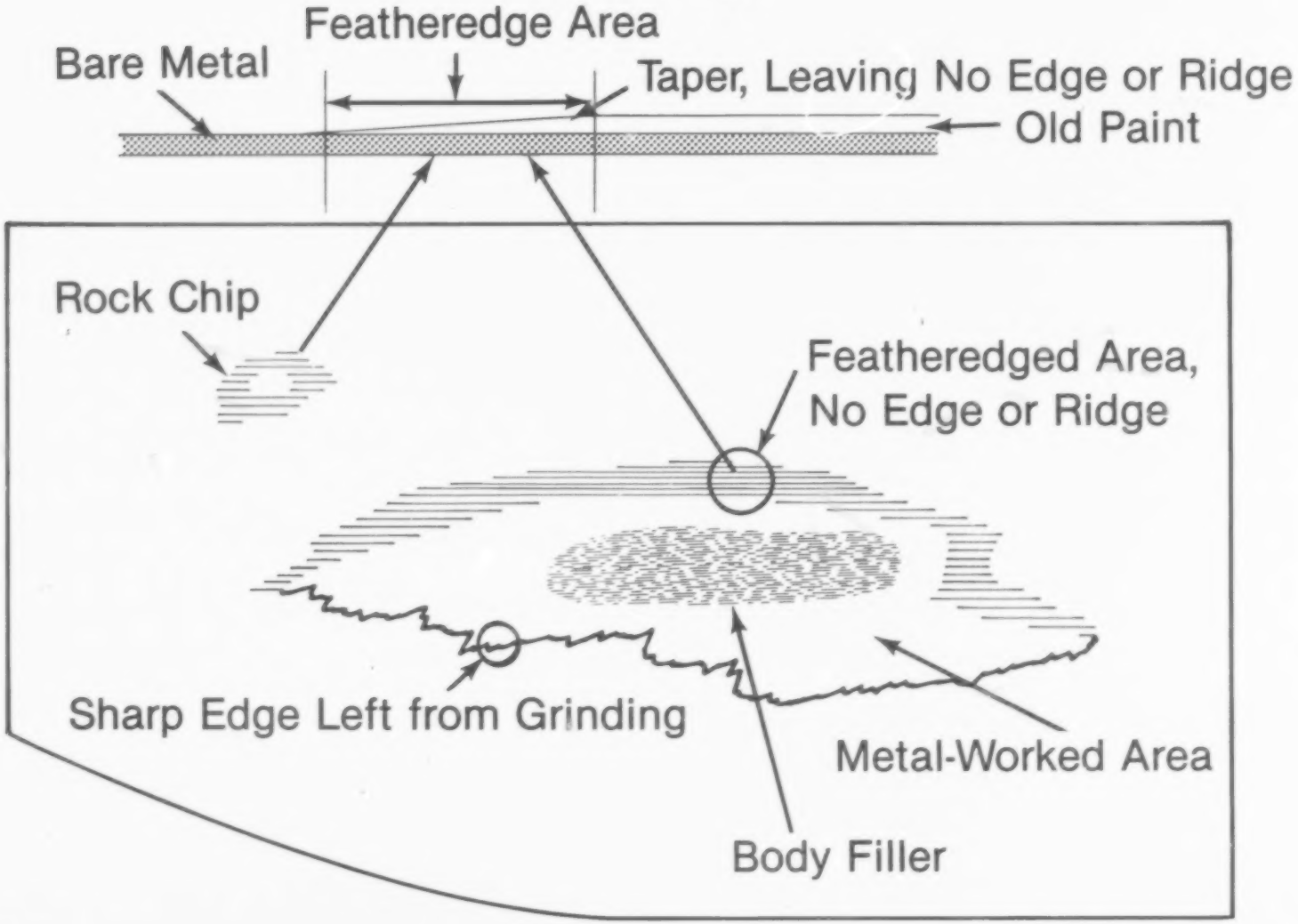
A. Crouse, William H., and Donald L. Anglin. *Automotive Body Repair and Refinishing,* 2nd ed. New York: McGraw-Hill Book Company/Gregg Division, 1986.

B. Manual, Edward F., and Wayman R. Penner. *Auto Body Repair and Repainting.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, 1974.

Back-Sanding



Featheredge



PREPARING SURFACES FOR PAINT
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Sanding — Using abrasive paper to smooth vehicle finish and leave fine scratches or "tooth" so that new paint will adhere to old finish

B. Chemical stripping — Using caustic material to remove old finish to the bare metal

C. Back-sanding — Sanding back from a featheredge area when preparing for primer-surfacer

D. Scuff-sanding — Using very fine sandpapers to rough up primers and some sealers when dirt nibs need to be removed and before the application of some clear finishes

E. Featheredging — Tapering paint edge from base metal to topcoat

F. Sandblasting — Using sand or other abrasive material under high pressure to remove rust and old finish

G. Grit — Abrasive coating on sandpaper

H. Wet-or-dry abrasive — Type of sandpaper designed for either wet or dry application

I. Sand scratches — Marks made in metal or old finish by abrasives; also marks that show in finish coat due to lack of fill or sealing

J. Nib — Tiny dirt particle on paint surface

K. Hot spot — Paint failure that results when chemical stripper has not been neutralized or completely removed from vehicle surface before painting

L. Gouging (scarring) — Marks that result from improper use of grinders or sanders when removing finishes

M. Lacquer-removing solvent — Chemical stripper used to remove lacquer finishes; does not disturb factory-applied primers

N. Paint remover — Chemical stripper containing fast-acting blend of solvents used to remove enamels, lacquers, and varnishes

INFORMATION SHEET

II. Methods of removing old paint

A. Sandblasting

(NOTE: High-pressure sandblasting is seldom used in the auto-body shop today. Some low-pressure sandblasting is suitable in the auto-body shop for heavy rust. It can be used on the inside of pickup beds, on inner aprons, on wheels, and on trucks and industrial equipment with large areas of rust, but not on any outer panels. Sandblasting easily damages plastic panels beyond repair. In addition, all chrome, glass, and plastic must be double-masked for protection.)

B. Chemical stripping

(NOTE: Many technicians prefer to remove paint by sanding and grinding instead of using chemical stripper because sanding and grinding are more convenient and less messy. For example, chemical stripper will soften any plastic body filler, which will then have to be replaced. Also, the use of chemical stripper requires a well-ventilated area and the use of protective clothing including safety goggles, respirator, cap, coveralls, and industrial rubber gloves.)

C. Grinding and sanding

(NOTE: Grinding and sanding are the most common methods of removing old paint. However, the method used is not always a simple matter of preference. To determine whether a vehicle needs to be sanded or stripped, refer to paint failure section of Unit V, "Mixing and Applying Topcoats.")

III. Purposes of sanding

A. Obtaining a smooth surface for new paint

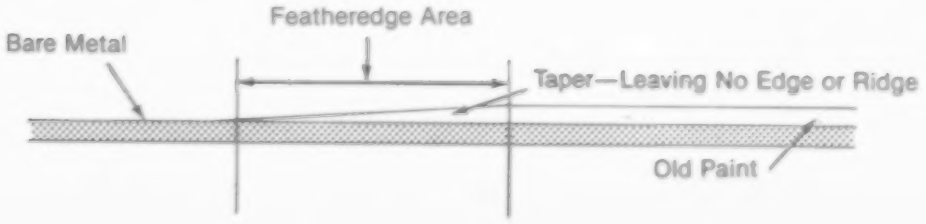
B. Providing a "tooth" for new paint adhesion

C. Removing defects such as sand pits, scratches, and dirt

D. Removing old, defective paint

IV. Purpose of featheredging — To prevent broken edge from showing through new paint by gradually tapering old paint finish to base surface, thus providing an uninterrupted smooth surface (Figure 1)

FIGURE 1



INFORMATION SHEET

V. Characteristics of wet sanding and dry sanding

A. Wet sanding

1. Prevents paper clogging

2. Washes away sanding residue that could cause scratches

3. Allows technician to see and check surface as it is continually rinsed

B. Dry sanding

1. Is faster than wet sanding

2. Does not require remasking of panels because of wet tape or paper

3. Absence of wet floor conditions makes work area safer than that for wet sanding

VI. Wet-sanding applications

A. On bare metal and undercoats to smooth them before application of topcoats

B. After guide coat has been sprayed on

C. Over primer-surfacer when acrylic lacquer is to be topcoat

VII. Guidelines for hand sanding

A. Never sand in the spray booth

B. Always use a sanding block or pad to distribute pressure evenly over entire area

(NOTE: Holding the sandpaper in the hand results in a very uneven sanding job and will leave finger marks on the vehicle surface.)

C. Sand only in one direction

D. Let the sandpaper do most of the work; do not apply too much pressure

(NOTE: Too much pressure will cause the sandpaper to clog and will produce sand scratches.)

PREPARING SURFACES FOR PAINT
UNIT II

JOB SHEET #1 — FEATHEREDGE BROKEN PAINT

I. Equipment and materials

A. Vehicle panel or scrap metal with area of broken paint

B. Sanding block and assortment of sandpaper

C. Orbital or oscillating sander and assortment of sanding discs

D. Disc adhesive

E. Detergent and bucket of water

F. Clean white shop towel or paper towels

G. Wax and grease remover

H. Masking tape

I. Appropriate tools for removing trim if necessary

J. Particle mask or respirator

K. Face shield

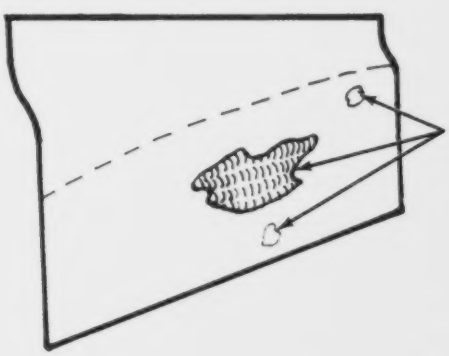
L. Leather gloves

M. Eye protection

II. Procedures

(NOTE: If several areas need to be featheredged in the same panel, remove the paint from the total area as shown in Figure 2.)

FIGURE 2



Remove paint from entire area, leaving only one featheredged area.

JOB SHEET #1

A. Clean area to be featheredged

1. Wash thoroughly with detergent and water
2. Dry with a soft, clean cloth or paper towel
3. Clean with wax and grease remover, following label instructions and cautions

B. Protect areas that could be damaged during featheredging process

1. Remove any moldings or trim in featheredge area
2. Mask adjacent panels or glass
3. Remove any hardware in area

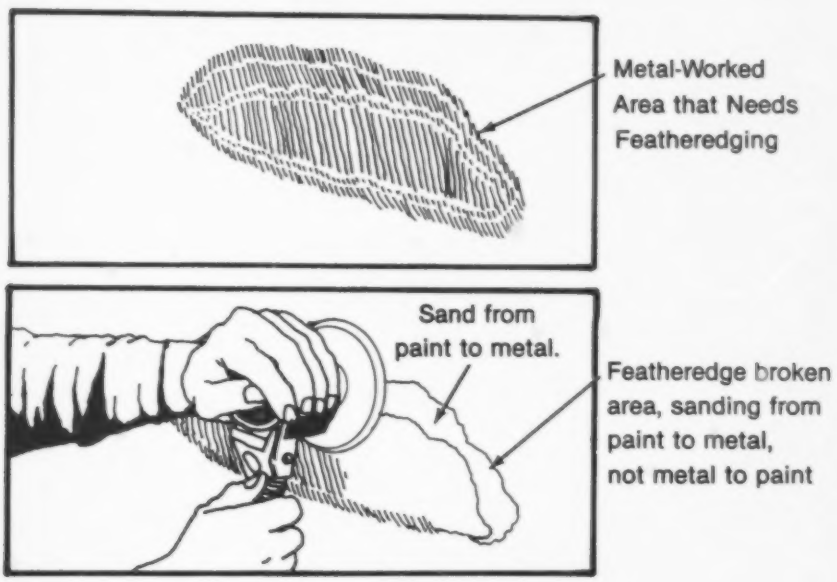
C. Sand broken paint edge until smooth with base metal surface

1. Put on protective clothing and eye protection
2. Decide whether to use hand sanding block, orbital sander, oscillating sander, or a combination of these methods
3. Back-sand paint from painted surface into damaged area as shown in Figure 3

CAUTION

Do not allow sander to come in contact with plastic filler if used. If the sander contacts filler, it will cut the filler down and leave an edge around the filler that will show when paint is applied.

FIGURE 3


Metal-Worked Area that Needs Featheredging
Sand from paint to metal.
Featheredge broken area, sanding from paint to metal, not metal to paint

JOB SHEET #1

D. Check area to be sure that all grinding scratches have been removed from paint

E. Show work to instructor after area has been featheredged

F. · Clean work area and return equipment and materials to proper storage

PREPARING SURFACES FOR PAINT
UNIT II

JOB SHEET #2 — WET-SAND FOR A COMPLETE PAINT JOB

I. Equipment and materials

A. Undamaged vehicle that requires a complete paint job

B. Sanding block and appropriate sandpapers

C. Water bucket and Tide or other nonpetroleum-based detergent

D. Sponge, clean white cloths, and paper towels

E. Plastic protective cover for protecting engine compartment

F. Scuff pads and steel wool

G. Rubber boots and rubber apron

H. Eye protection and particle mask or respirator

I. Air gum

J. Masking tape

K. Wax and grease remover

II. Procedure

CAUTION

The wet floor conditions created by wet-sanding are a hazard. Take care to prevent slipping.

A. Put on rubber boots and rubber apron

B. Open vehicle hood and protect carburetor, ignition, and oil inlet from water with plastic cover

C. Wash vehicle with water and detergent solution

(NOTE: Wash the vehicle an area at a time and do not leave the area until it is thoroughly clean and rinsed.)

1. Wash and rinse under hood

2. Wash and rinse door jambs

JOB SHEET #2

3. Wash and rinse under deck lid and deck-lid jambs

4. Wash exterior of vehicle; rinse

D. Clean exterior of vehicle with wax and grease remover, following label instructions and cautions

E. Examine type and condition of paint

F. Mask trim, moldings, and hardware as necessary

G. Put on particle mask, respirator, and eye protection

H. Block-sand and hand-sand vehicle a section at a time

I. Wet-sand vehicle exterior in order listed below—sanding, rinsing, and drying each area thoroughly before moving to next area

1. Top

2. Right side body panels

3. Rear body panels

4. Left side body panels

5. Front-end assembly

J. Carefully wet-sand around moldings, trim, drip rails, and body seams

(NOTE: Most paint failures are the result of improper sanding around these areas. Do not fail to do this sanding properly and thoroughly.)

K. If color is to be changed, wet-sand door jambs; if color is to remain the same, scuff-pad or steel-wool only exposed areas of door jambs

L. Wet-sand front fender jambs and under hood

M. Wet-sand deck lid and deck-lid jambs

N. Wash vehicle exterior and door jambs, wheel wells, under hood, and deck-lid areas with detergent and water; rinse and blow dry with air gun

O. Clean work area and return equipment and materials to proper storage

PREPARING SURFACES FOR PAINT
UNIT II

JOB SHEET #3 — DRY-SAND FOR A COMPLETE PAINT JOB

I. Equipment and materials

A. Undamaged vehicle that requires a complete paint job

B. Sanding block and appropriate sandpapers

C. Water bucket and Tide or other nonpetroleum-based detergent

D. Sponge, clean white cloths, and paper towels

E. Plastic protective cover for protecting engine compartment

F. Scuff pads and steel wool

G. Orbital or oscillating sander and appropriate abrasive discs

H. Particle mask or respirator

I. Full-face shield

J. Rubber boots and rubber apron

K. Eye protection

L. Air gun

M. Masking tape

N. Wax and grease remover

II. Procedure

A. Put on rubber boots and rubber apron

B. Open vehicle hood and protect carburetor, ignition, and oil inlet from water with plastic cover

C. Wash vehicle with water and detergent solution

(NOTE: Wash the vehicle an area at a time and do not leave the area until it is thoroughly clean and rinsed.)

1. Wash and rinse under hood

2. Wash and rinse door jambs

JOB SHEET #3

3. Wash and rinse under deck and deck-lid jambs

4. Wash exterior of vehicle; rinse

D. Clean exterior of vehicle with wax and grease remover, following label instructions and cautions

E. Examine type and condition of paint

F. Mask trim, moldings, and hardware as necessary

G. Put on particle mask or respirator, leather gloves, eye protection, and full-face shield

H. Block-sand and hand-sand vehicle a section at a time

I. Sand vehicle with orbital or oscillating sander in order listed below

1. Top

2. Right side body panels

3. Rear body panels

4. Left side body panels

5. Front-end assembly

J. Clean each panel thoroughly by blowing off grinding dust with air gun

(NOTE: Sand one area at a time, and do not leave that area until it has been thoroughly sanded and cleaned.)

K. Carefully hand-sand around moldings, trim, drip rails, and body seams

(NOTE: Most paint failures are the result of improper sanding around these areas. Do not fail to do this sanding properly and thoroughly.)

L. If color is to be changed, sand door jambs; if color is to remain the same, scuff-pad or steel-wool only exposed areas of door jambs

M. Sand front fender jambs and under hood

N. Sand deck lid and deck-lid jambs

O. Wash vehicle exterior and door jambs, wheel wells, under hood, and deck-lid areas with detergent and water; rinse and blow dry with air gun

P. Clean work area and return equipment and materials to proper storage

PREPARING SURFACES FOR PAINT
UNIT II

JOB SHEET #4 — SCUFF-SAND A SURFACE

I. Equipment and materials

A. Water bucket and Tide or other nonpetroleum-based detergent

B. Sponge, clean cloths, and paper towels

C. Sandpaper assortment

D. Wax and grease remover

E. Scuffing pad or steel wool

F. Eye protection and particle mask or respirator

G. Air gun

H. Rubber gloves and rubber apron

II. Procedure

(NOTE: Scuff-sanding is used when dirt nibs need removing before paint application or the application of some clear finishes.)

A. Put on eye protection, rubber gloves, and rubber apron

B. Wash entire surface to be scuff-sanded with detergent and water

C. Rinse area and dry with air gun or clean cloths

D. Lightly sand surface until dull with #400 grit or finer sandpaper, using either wet or dry method

(NOTE: Some refinishers use a scuffing pad or fine steel wool for this operation.)

E. Rinse area thoroughly and dry with clean, soft towels

F. Use air gun to dry cracks and around moldings

G. Clean work area and return equipment and materials to proper storage

PREPARING SURFACES FOR PAINT
UNIT II

JOB SHEET #5 — REMOVE PAINT WITH CHEMICAL STRIPPER

I. Equipment and materials

A. Chemical stripper

B. Water bucket and Tide or other nonpetroleum-based detergent

C. Appropriate tools for removing moldings and emblems

D. Putty knife

E. Old coffee can or metal container

F. Wire brush

G. Masking tape

H. Paintbrush

I. Wax and grease remover

J. Eye protection

K. Coveralls and industrial rubber gloves

L. OSHA-approved respirator

II. Procedure

A. Set up work station in well-ventilated area

B. Prepare surface for paint removal

1. Wash vehicle as necessary with detergent and water

2. Remove all moldings and emblems from repair area

3. Clean surface with wax and grease remover, following label instructions and cautions

4. Mask any moldings or emblems that cannot be removed

(NOTE: Chemical stripper will dissolve many plastics. Do not use it on or allow it to come in contact with plastics.)

C. Put on protective clothing, eye protection, and respirator

JOB SHEET #5

D. Read and follow all instruction and caution labels on chemical stripper container

> **CAUTION**
>
> Chemical stripper is toxic. Wear required protective clothing and use only in a well-ventilated area.

E. Brush liberal amount of chemical stripper on small section of vehicle about 1 foot square, brushing in one direction only

(NOTE: If too much area is coated with remover, the remover will harden and require additional work. If too little remover is used [too thin a coat], the paint will not be softened or lifted and the process will have to be repeated.)

F. Allow remover to work for amount of time indicated on container

(NOTE: If the remover is removed from the painted surface too soon, the paint will not be lifted from the surface and the process will have to be repeated.)

G. Remove paint from surface by scraping with a putty knife and brushing with wire brush; put removed paint in old coffee can or metal container

(NOTE: Use a flexible putty knife on fiberglass. If the surface has been repaired with body filler, the paint remover will have softened the filler. Any areas so affected require refilling.)

H. Wash surface thoroughly with water to cleanse surface and neutralize remover

I. Repeat steps E through H on small areas of affected surface until all paint has been removed

(NOTE: Always finish one panel or section before continuing to the next. This will result in a professional job.)

J. Clean work area and return equipment and materials to proper storage

PREPARING SURFACES FOR PAINT
UNIT II

JOB SHEET #6 — PREPARE AN UNPAINTED ALUMINUM PANEL FOR REFINISHING

I. Equipment and materials

A. Water bucket and Tide or other nonpetroleum-based detergent

B. Trisodium phosphate or steam cleaner

C. Wax and grease remover (precleaner)

D. Metal conditioner

E. Zinc chromate or other aluminum primer

F. Sanding block and #400-grit sandpaper

G. Blow gun

H. Tack rag

I. Rubber gloves and rubber apron

J. Final cleaner

K. Spray gun

L. Strainer

M. Eye protection

N. OSHA-approved respirator

II. Procedure

(NOTE: If topcoats are to stick to aluminum metal properly, a definite procedure must be followed. Manufacturers of aluminum often spray or dip-coat their panels with an oily solution after they are manufactured to prevent them from corroding. To prepare aluminum properly for refinishing, this oily coating must be removed.)

A. Set up work area in well-ventilated area

B. Put on rubber gloves and apron

C. Wash panel thoroughly in hot soapy water

D. Rinse panel thoroughly and allow to dry

JOB SHEET #6

E. Remove any remaining oil or grease deposits by washing panel with trisodium phosphate or by steam cleaning

F. Wash panel with wax and grease remover, following directions and cautions on solvent container and wiping solvent from surface before it dries

G. Treat all bare metal with metal conditioner, wiping conditioner off panel before it dries and following directions and cautions on conditioner label

H. Wipe panel with tack rag

I. Apply zinc chromate or other aluminum primer to panel, following label instructions and cautions; allow to dry for at least 30 minutes

J. Block-sand aluminum primer with wet #400 sandpaper

K. Wash panel surface with final cleaner, following directions and cautions on cleaner label and wiping off final cleaner before it dries on panel surface

L. If panel is mounted on a body, use air gun to blow all dust out of cracks near panel

M. Wipe surface with a tack rag

(NOTE: The panel is now ready for sealer and topcoat.)

N. Clean work area and return equipment and materials to proper storage

PREPARING SURFACES FOR PAINT
UNIT II

JOB SHEET #7 — PREPARE AN UNPAINTED GALVANIZED PANEL FOR REFINISHING

I. Equipment and materials

A. Water bucket and Tide or other nonpetroleum-based detergent

B. Trisodium phosphate

C. Wax and grease remover

D. Galvanized primer and activator or multipurpose lacquer primer

E. Spray gun

F. Metal conditioner

G. Putty

H. Sanding block and #400-grit sandpaper

I. Tack rag

J. Clean cloths and paper towels

K. Rubber gloves and rubber apron

L. Blow gun

M. Strainer

N. Eye protection

O. OSHA-approved respirator

P. Rubber squeegee

II. Procedure

(NOTE: Today, more automobile manufacturers are using galvanized panels and pieces than they have in the past. The auto-body technician must know how to work with galvanized metal and how to prepare it for painting. Because of its zinc coating, galvanized metal is one of the most difficult surfaces on which to make paint stick. Galvanized metal must be carefully prepared if the topcoat is to adhere properly to the substrate.)

A. Set up work area in well-ventilated area

B. Put on rubber gloves and apron

C. Wash panel thoroughly with hot, soapy water

JOB SHEET #7

D. Rinse panel and allow to dry

E. Wash panel thoroughly with water and trisodium phosphate

F. Rinse with clear water and allow to dry

G. Wash panel with wax and grease remover, following directions and cautions on label and wiping remover off surface before it dries

H. Treat all bare galvanized metal with metal conditioner, following directions and cautions on conditioner label and wiping off conditioner before it dries

I. Blow dust out of any cracks with compressed air

J. Wipe panel with tack rag

K. Thoroughly mix and strain correct amounts of galvanized primer and activator, carefully following mixing directions on the can

(NOTE: Do not substitute any other product for the galvanized primer.)

L. Fill spray gun

M. Spray a *thin* coat of galvanized primer on clean metal

N. Allow primer to dry for 30 minutes

O. Fill any imperfections in the primer with putty

P. Allow putty and primer to dry overnight

Q. Block-sand primed surface of panel with #400 wet sandpaper

R. Reprime puttied areas

S. Wash panel with final cleaner, following directions and cautions on container label and wiping final cleaner from panel surface before it dries

T. Blow dust out of any cracks around panel

U. Wipe prepared surface with a tack rag

(NOTE: The panel is now ready for sealer and topcoat.)

V. Clean work area and return equipment and materials to proper storage

PREPARING SURFACES FOR PAINT
UNIT II

TEST

NAME _____ SCORE _____

1. Match to their correct definitions terms associated with preparing surfaces for paint. Write the correct numbers in the blanks.

_____a. Marks made in metal or old finish by abrasive; also marks that show in finish coat due to lack of fill or sealing

_____b. Sanding back from a featheredge area when preparing for primer-surfacer

_____c. Using very fine sandpapers to rough up primers and some sealers when dirt nibs need to be removed before the application of some clear finishes

_____d. Abrasive coating on sandpaper

_____e. Tiny dirt particle on paint surface

_____f. Tapering paint edge from base metal to topcoat

_____g. Using abrasive paper to smooth vehicle finish and leave fine scratches or "tooth" so that new paint will adhere to old finish

_____h. Type of sandpaper designed for either wet or dry application

_____i. Paint failure that results when chemical stripper has not been neutralized or completely removed from vehicle surface before painting

_____j. Marks that result from improper use of grinders or sanders when removing finishes

_____k. Chemical stripper containing fast-acting blend of solvents used to remove enamels, lacquers, and varnishes

_____l. Chemical stripper used to remove lacquer finishes; does not disturb factory-applied primers

_____m. Using caustic material to remove old finish to the bare metal

_____n. Using sand or other abrasive material under high pressure to remove rust and old finish

1. Scuff-sanding
2. Back-sanding
3. Sanding
4. Featheredging
5. Wet-or-dry abrasive
6. Nib
7. Grit
8. Sand scratches
9. Gouging (scarring)
10. Paint remover
11. Lacquer-removing solvent
12. Chemical stripper
13. Hot spot
14. Chemical stripping
15. Sandblasting

TEST

2. List methods of removing old paint.

   a. _____

   b. _____

   c. _____

3. Select from the following list the purposes of sanding. Write an "X" in the blank before each correct answer.

   _____a. Providing deep scratches for new paint adhesion

   _____b. Obtaining a smooth surface for new paint

   _____c. Removing defects such as sand pits, scratches, and dirt

   _____d. Removing old, defective paint

   _____e. Dulling new paint surface

   _____f. Providing a "tooth" for new paint adhesion

4. State the purpose of featheredging.

   Purpose of featheredging — _____

   _____

   _____

5. Compare characteristics of wet sanding and dry sanding.

   Wet sanding

   a. _____

   b. _____

   c. _____

   Dry sanding

   a. _____

   b. _____

   c. _____

TEST

6. Select from the following list wet-sanding applications. Write an "X" in the blank before each correct answer.

   _____a. On painted surfaces to smooth them before application of topcoats

   _____b. On bare metal and undercoats to smooth them before application of topcoats

   _____c. Before guidecoat has been sprayed on

   _____d. After guidecoat has been sprayed on

   _____e. Over primer-surfacer when acrylic lacquer is to be topcoat

   _____f. Over primer-surfacer when acrylic lacquer is to be base coat

7. List guidelines for hand sanding.

   a. _____

   b. _____

   c. _____

   d. _____

(NOTE: Test item 8 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

8. Demonstrate the ability to

   a. Featheredge broken paint.

   b. Wet-sand for a complete paint job.

   c. Dry-sand for a complete paint job.

   d. Scuff-sand a surface.

   e. Remove paint with chemical stripper.

   f. Prepare an unpainted aluminum panel for refinishing.

   g. Prepare an unpainted galvanized panel for refinishing.

PREPARING SURFACES FOR PAINT
UNIT II

ANSWERS TO TEST

1.

a. 8	e. 6	i. 12	m. 13
b. 2	f. 4	j. 9	n. 14
c. 1	g. 3	k. 10	
d. 7	h. 5	l. 11	

2. a. Sandblasting
   b. Chemical stripping
   c. Grinding and sanding

3. b, c, d, f

4. To prevent broken edge from showing through new paint by gradually tapering old paint finish to base surface, thus providing uninterrupted smooth surface

5. **Wet sanding**

   a. Prevents paper clogging
   b. Washes away sanding residue that could cause scratches
   c. Allows technician to see and check surface as it is continually rinsed

   Dry sanding

   a. Is faster than wet sanding
   b. Does not require remasking of panels because of wet tape or paper
   c. Absence of wet floor conditions makes work area safer than that for wet standing

6. b, d, e

7. a. Never sand in the spray booth
   b. Always use sanding block or pad to distribute pressure evenly over entire area
   c. Sand only in one direction
   d. Let the sandpaper do most of the work; do not apply too much pressure

8. Performance skills evaluated to the satisfaction of the instructor

MASKING
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to mask a vehicle for spot repairs, panel repairs, and for a complete paint job. The student will show this ability by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with masking.
2. Select from a list guidelines for effective application of masking paper and tape.
3. List guidelines for removing masking.
4. Demonstrate the ability to
   a. Mask a vehicle for spot repair.
   b. Mask a vehicle for panel repair.
   c. Mask a vehicle for a complete paint job.

MASKING
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1 — Mask a Vehicle for Spot Repair

2. Job Sheet #2 — Mask a Vehicle for Panel Repair

3. Job Sheet #3 — Mask a Vehicle for a Complete Paint Job

E. Test

F. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Order or obtain materials needed to supplement unit.

1. Equipment and materials for job sheet procedures

2. Filmstrips

(NOTE: The following filmstrips are available from Teaching Aids Incorporated, Post Office Box 1798, Costa Mesa, California 92628-0798.)

a. *Auto Body: Masking for Refinishing*

(NOTE: This filmstrip outlines masking techniques for a variety of automobile panels as well as for complete refinishing. Double masking, reverse tape masking, and the application of paper with and without an apron taper are discussed.)

b. *Masking*

(NOTE: This filmstrip describes why and where differenct widths of masking tape and paper should be used. The filmstrip also illustrates masking techniques used on moldings, glass, and accessories before painting.)

3. Filmstrip projector

SUGGESTED ACTIVITIES

4. Examples of various widths of masking tape and examples of masking papers and plastics

5. Competency profiles

   (NOTE: Competency profiles for this manual are available from the State Department of Vocational and Technial Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

C. Provide students with unit.

D. Introduce unit.

   SUGGESTIONS:

   - Discuss unit and specific objectives. Explain that accomplishment of the specific objectives leads to achievement of the unit objective.
   - Show filmstrip *Auto Body: Masking for Refinishing*. Discuss with class.

E. Discuss information and job sheets.

1. Use Information Sheet, Section I to introduce students to terms associated with vehicle masking.

   SUGGESTION:

   - Show students examples of appropriate terms.

2. Use Information Sheet, Sections II and III to discuss guidelines for effective application and removal of masking.

   SUGGESTIONS:

   - Show filmstrip *Masking*. Discuss with the class.
   - Allow students to practice some of the techniques illustrated in the filmstrip.
   - Demonstrate what happens when vehicle is masked improperly.
   - Demonstrate what happens when tape is removed before paint is ready.
   - Show students how masking tape will not adhere to a damp surface.
   - Demonstrate how to reverse tape, how to apply two layers of paper to prevent bleeding, and how to apply tape to curved components.
   - Show students how stretched tape creates creeping problems.
   - Show students what happens when tape is applied to a cold panel.

SUGGESTED ACTIVITIES

- Demonstrate and discuss each of the job sheets. Assign completion dates and allow students to complete job sheets under your supervision.

F. Give test.

G. Critique test and discuss in class.

H. Complete appropriate section of competency profiles.

III. Unit references

A. Crouse, William H., and Donald L. Anglin, *Automotive Body Repair and Refinishing*, 2nd ed. New York: Gregg Division of McGraw-Hill Book Company, 1986.

B. Manual, Edward F., and Wayman R. Penner. *Auto Body Repair and Repainting*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, 1974.

C. Rhone, L. C., and H. David Yates. *Total Auto Body Repair*, 2nd ed. Indianapolis: Bobbs-Merrill Education Publishing, 1983.

MASKING
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. Masking — Applying masking paper or plastic and tape to shield areas on vehicle not to be painted

B. Masking tape — Adhesive strip specially designed for masking of vehicles for spot repair, panel repair, and overall refinishing

C. Apron — Piece of paper or plastic with a strip of tape on one edge; used for masking glass, panels, and other areas that need protection from overspray

D. Overspray — Paint or other sprayed material that hits surfaces for which it is not intended

E. Masking paper — Specially designed paper that prevents paint from seeping through to protected surface

(NOTE: A masking plastic is now also available on the market.)

F. Apron taper — Masking paper and tape dispenser designed to apply tape to edge of paper as paper is pulled off roll

G. Reverse taping — Folding apron or strip of paper back over area to be protected

II. Guidelines for effective application of masking paper and tape

A. Apply to a clean, dry surface

(NOTE: Make sure that the areas around trim and emblems or nameplates are clean and dry. Masking tape will not stick to even slightly damp surfaces.)

B. Make sure that tape covers surface to be protected and does not overlap any surface to be painted

C. Do not stretch tape; when it shrinks back to its original shape, it will leave the area exposed

D. When spraying horizontal surface, prevent bleeding by using two layers of paper or reverse taping procedure

E. Never apply tape or remove tape from a cold vehicle; make sure that vehicle temperature is at least 60 degrees Fahrenheit

(NOTE: Tape applied to a cold vehicle is difficult to remove because the adhesive separates from the tape and bonds to the vehicle surface.)

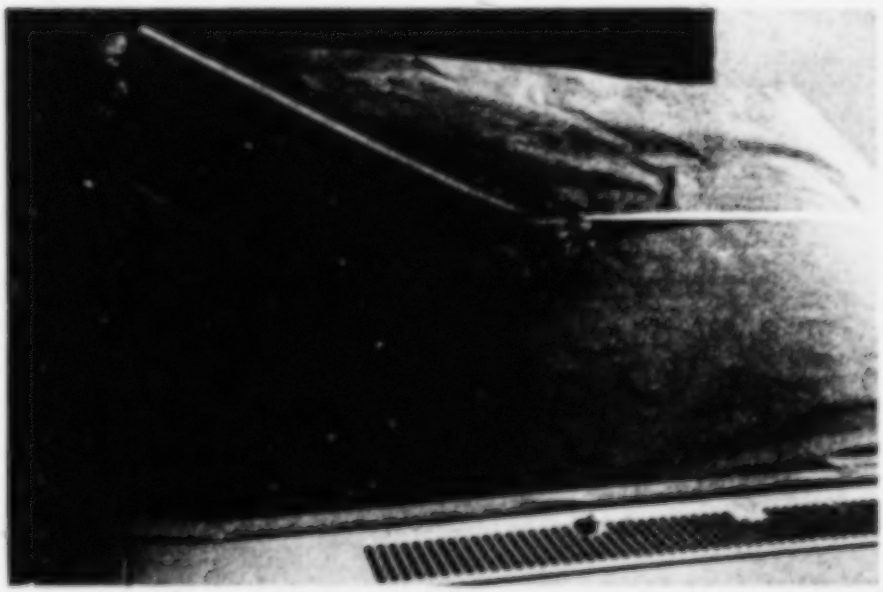
F. Use widest masking paper or plastic possible to keep down cost of paper and labor

INFORMATION SHEET

G. When masking large areas, be sure that top piece of paper (apron) overlaps bottom piece to prevent dust and water seepage to protected surfaces (Figure 1)

EXAMPLE:

FIGURE 1

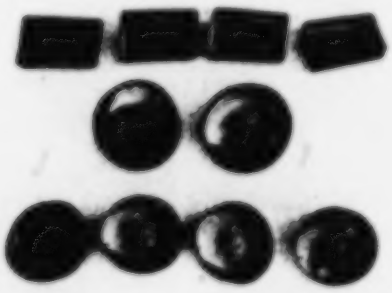


H. Use various widths of masking paper, plastic, or tape to thoroughly mask taillights and areas around them, or use plastic light covers (Figure 2) to simplify process

(NOTE: Protection of taillight and headlamp assemblies is important; overspray is particularly difficult to remove from some rear light lenses.)

EXAMPLE:

FIGURE 2



INFORMATION SHEET

I. When spraying door jambs, sills, and pillars, take care to prevent overspray from hitting interior of vehicle (Figure 3)

EXAMPLE:

FIGURE 3

J. Before taping rubber weatherstripping on doors or deck lid, apply a thin coat of clear lacquer and let dry; this prevents tape adhesive from remaining on weatherstripping when tape is removed

K. Whenever only part of one panel is to be refinished, use reverse masking technique or mask area to be painted along natural breaks to hide area where new paint stops and old paint begins

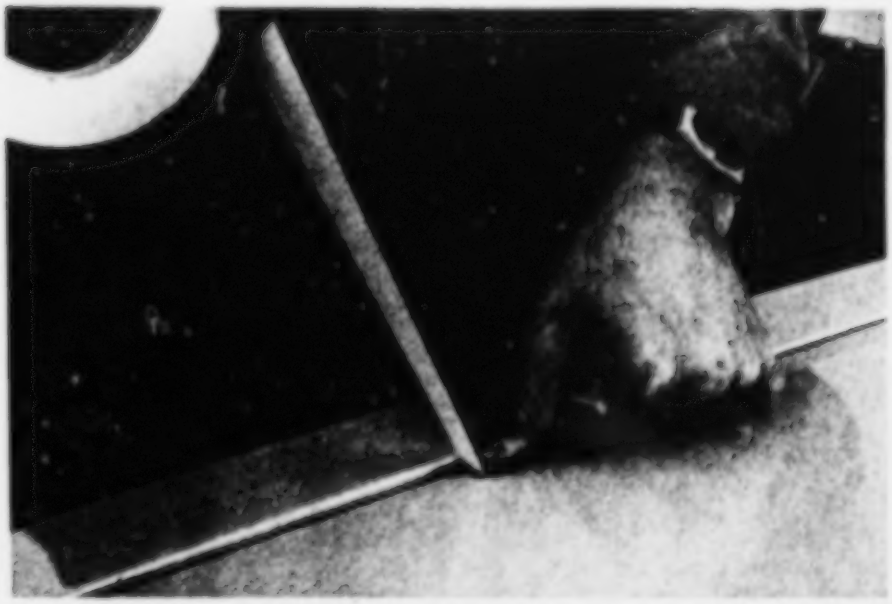
L. If need be, fold and tape any pleats in the paper to prevent sanding dust from collecting in them before painting

M. To cut masking tape correctly, quickly tear upwards against your thumbnail (See Figure 4)

INFORMATION SHEET

EXAMPLE:

FIGURE 4



N. Store tape in a cool place so that it will retain its elasticity and stickiness

III. Guidelines for removing masking

A. Remove before paint has completely set up

B. Touch fresh paint *on masking* to see if tape can be removed; if paint is slightly tacky, tape may be removed

C. Remove tape by pulling straight up from surface at 90-degree angle

MASKING
UNIT III

JOB SHEET #1 — MASK A VEHICLE FOR SPOT REPAIR

I. Equipment and materials

A. Masking tape of various widths

B. Masking papers or plastics

C. Apron taper

D. Cleaning materials

E. Towels

F. Appropriate tools for removing any trim necessary

G. Eye protection

H. Air gun

I. Sharp knife or razor blade

II. Procedure

A. Put on eye protection

B. Remove any emblems or trim that will not be masked

C. Clean any chrome, moldings, or trim remaining in area to be masked; blow dry with compressed air

D. Clean adjacent panels as necessary; blow dry with compressed air

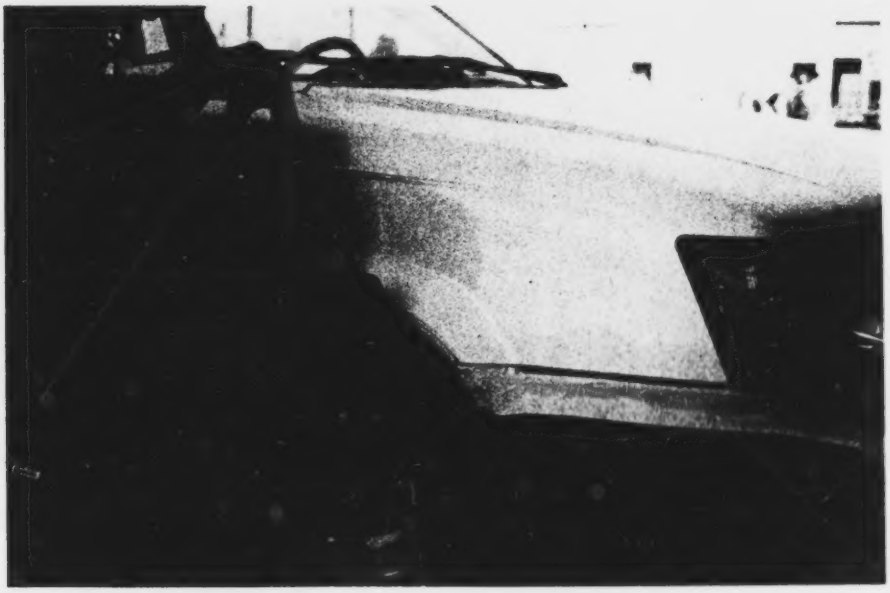
E. Use narrow (1/4-inch wide) masking tape to mask any small emblems or lettering remaining in the area to be painted; press tape down firmly (Figure 5)

FIGURE 5

JOB SHEET #1

F Use 3/4-inch tape to cover any body trim in area (Figure 6)

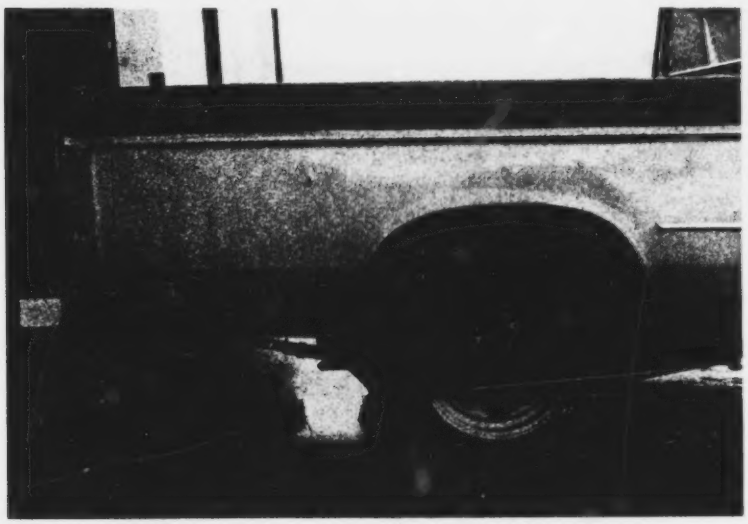
FIGURE 6



G. Use masking aprons to protect chrome and adjacent panels (Figure 7)

(NOTE: Do not tape across panel to be spot refinished. This area must be left open to provide a blend area with old paint.)

FIGURE 7



JOB SHEET #1

H. Mask any remaining areas that need to be protected from overspray

I. Inspect your work to make sure that no tape adheres to panel to be spot repaired

J. Trim any excess tape carefully with sharp knife or razor blade

K. Clean work area and return equipment and materials to proper storage

MASKING
UNIT III

JOB SHEET #2 — MASK A VEHICLE FOR PANEL REPAIR

I. Equipment and materials

A. Masking tape of various widths

B. Masking papers or plastics

C. Apron taper

D. Cleaning materials

E. Towels

F. Appropriate tools for removing any trim necessary

G. Sharp knife or razor blade

H. Clear lacquer and small paintbrush

I. Eye protection

II. Procedure

A. Put on eye protection

B. Remove any emblems or trim that will not be masked

C. Clean any chrome, moldings, or trim remaining in area to be masked; blow dry with compressed air

D. Clean adjacent panels as necessary; blow dry

E. Use narrow (1/4-inch wide) masking tape to mask any small emblems or lettering remaining in area to be painted; press tape down firmly

(NOTE: Technicians often use a pocket knife to work the tape into place on the edges of small trim.)

F. Use 3/4-inch tape to cover any body trim in area

G. Mask door handle and any other chrome or trim remaining on panel to be painted (See Figure 8)

JOB SHEET #2

FIGURE 8

H. **Apply clear lacquer to weatherstripping on doors and deck as necessary;** allow to dry

I. Mask door jamb, door lock assembly, and striker bolt, using masking aprons on door jambs to prevent overspray from entering interior (Figure 9)

FIGURE 9

JOB SHEET #2

J. Mask panel, masking along natural breaks so that old and new paint will blend well

K. Inspect your work to make sure that no tape adheres to panel to be painted

L. Trim any excess tape carefully with sharp knife or razor blade

M. Clean work area and return equipment and materials to proper storage

MASKING
UNIT III

JOB SHEET #3 — MASK A VEHICLE FOR A COMPLETE PAINT JOB

I. Equipment and materials

A. Masking tape of various widths

B. Masking papers or plastics

C. Plastic light covers appropriate for vehicle being worked on

D. Apron taper

E. Appropriate tools for removing any trim necessary

F. Cleaning materials

G. Towels

H. Sharp knife or razor blade

I. Eye protection

II. Procedure

A. Put on eye protection

B. Remove any emblems, trim, or hardware that will not be masked

C. Clean all windows; blow dry with compressed air

D. Clean any chrome, trim, or hardware remaining; blow dry with compressed air

E. Blow off entire vehicle with compressed air and then check with instructor to see whether vehicle is clean enough to be masked

F. Mask off all windows, making sure to lap top aprons over bottom ones to prevent dust and water seepage to protected area (See Figure 10)

JOB SHEET #3

FIGURE 10

G. Use sharp knife or razor blade to trim excess paper or plastic

H. Check chrome around windshield and windows to make sure that there is no excess tape; trim excess tape with sharp knife or razor blade

I. Mask off all front and rear lights, using plastic light covers if available (Figure 11), or using various widths of masking tape (Figure 12)

FIGURE 11

JOB SHEET #3

FIGURE 12

J. Mask any remaining emblems or small lettering with 1/4-inch tape; press down firmly

K. Mask bumpers and any remaining body trim with tape of appropriate width; press tape down firmly and use pocket knife to work into place if necessary

L. Apply clear lacquer to weatherstripping on doors and deck lid as necessary; allow to dry

M. Mask door jambs, door lock assemblies, and striker bolts, using masking aprons on door jambs to prevent overspray from entering interior

N. Mask each panel separately along natural breaks so that old and new paint will blend well

O. Inspect your work to make sure that tape is adhering properly to masked areas and that no tape is adhering to areas to receive paint

P. Make adjustments and carefully trim any excess tape or paper where necessary

Q. Clean work area and return equipment and materials to proper storage

MASKING
UNIT III

TEST

NAME _____ SCORE _____

1. Match to their correct definitions terms associated with masking. Write the correct numbers in the blanks.

_____a. Folding apron or strip of paper back over area to be protected

_____b. Adhesive strip specially designed for masking of vehicles for spot repair, panel repair, and overall refinishing

_____c. Specially designed paper that prevents paint from seeping through to protected surface

_____d. Applying masking paper or plastic and tape to shield areas on vehicle not to be painted

_____e. Paint or other sprayed material that hits surfaces for which it is not intended

_____f. Masking paper and tape dispenser designed to apply tape to edge of paper as paper is pulled off roll

_____g. Piece of paper or plastic with strip of tape on one edge; used for masking glass, panels, and other areas that need protection from overspray

1. Masking
2. Masking tape
3. Apron
4. Overspray
5. Masking paper
6. Apron taper
7. Reverse taping

2. Select from the following list guidelines for effective application of masking paper and tape. Write an "X" in the blank before each correct answer.

_____a. Apply to a clean, waxed surface

_____b. Make sure that tape covers surface to be protected and does not overlap any surface to be painted

_____c. Do not stretch tape; when it shrinks back to its original shape, it will leave the area exposed

_____d. When spraying vertical surfaces, prevent bleeding by using three layers of paper or reverse taping procedure

_____e. Never apply tape or remove tape from a hot vehicle; make sure that vehicle temperature is at least 30 degrees Fahrenheit

_____f. Use narrowest masking paper or plastic possible to keep down cost of paper and labor

_____g. When masking large areas, be sure that top piece of paper (apron) overlaps bottom piece to prevent dust and water seepage to protected surfaces

_____h. Use various widths of masking paper, plastic, or tape to thoroughly mask taillights and areas around them, or use plastic light covers to simplify process

_____i. When spraying door jambs, sills, and pillars, take care to prevent overspray from hitting interior of vehicle

_____j. Before taping weatherstripping on doors or deck lid, apply a thin coat of clear lacquer and let dry; this prevents tape adhesive from remaining on weatherstripping when tape is removed

_____k. Whenever only part of one panel is to be refinished, use reverse masking technique or mask area to be painted along natural breaks to hide area where new paint stops and old paint begins

_____l. If need be, create pleats in the paper to trap sanding dust before painting

_____m. Cut masking tape correctly by using sharp scissors or razorblade knife

_____n. Store tape in a warm place so that it will retain its elasticity and stickiness

3. List guidelines for removing masking.

   a. _____

   b. _____

   c. _____

(NOTE: Test item 4 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

4. Demonstrate the ability to

   a. Mask a vehicle for spot repair.

   b. Mask a vehicle for panel repair.

   c. Mask a vehicle for a complete paint job.

MASKING
UNIT III

ANSWERS TO TEST

1. a. 7
   b. 2
   c. 5
   d. 1
   e. 4
   f. 6
   g. 3

2. b, c, g, h, i, j, k

3. a. Remove before paint has completely set up
   b. Touch fresh paint *on masking* to see if tape can be removed; if paint is slightly tacky, tape may be removed
   c. Remove tape by pulling straight up from surface at 90-degree angle

4. Performance skills evaluated to the satisfaction of the instructor

MIXING AND APPLYING UNDERCOATS
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to mix and apply automotive paint undercoats. The student will show this knowledge by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with automotive paint undercoats.
2. Arrange in order the sequence of steps in painting a vehicle.
3. Select correct descriptions of paint undercoat materials.
4. List the four basic paint undercoats.
5. Discuss factors to consider when choosing a paint undercoat.
6. List qualities of good primer-surfacer.
7. Discuss reasons for applying sealer.
8. Select from a list guidelines for quality undercoating.
9. Demonstrate the ability to
    a. Mix and apply acrylic lacquer primer-surfacer, guide coat, and sealer.
    b. Mix and apply nonsanding enamel primer-sealer.
    c. Mix and apply epoxy primer.
    d. Prime and seal a replacement panel.

MIXING AND APPLYING UNDERCOATS
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1 — Mix and Apply Acrylic Lacquer Primer-Surfacer, Guide Coat, and Sealer

2. Job Sheet #2 — Mix and Apply Nonsanding Enamel Primer-Sealer

3. Job Sheet #3 — Mix and Apply Epoxy Primer

4. Job Sheet #4 — Prime and Seal a Replacement Panel

E. Test

F. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Order or obtain materials needed to supplement unit.

1. Equipment and materials for job sheet performance

2. Samples of different undercoat materials and products

3. Audiovisual aids

(NOTE: Filmstrips *a* and *b* are available from Teaching Aids Incorporated, Post Office Box 1798, Costa Mesa, California 92628-0798.)

a. *Surface Preparation for Repainting*, 1 cassette, 1 filmstrip, 1 worksheet

(NOTE: This filmstrip illustrates the uses of lacquer primer, guide coat, block and finish sanding, and explains how to prepare automotive sheet metal for painting.)

b. *Paint, Preparation and Materials*, 1 cassette, 1 filmstrip

(NOTE: This filmstrip examines the nature of paint in detail and considers special application techniques for the various paint systems and their additives. In addition, surface preparation through the use of solvents, metal conditioners, and conversion coatings is examined in detail.)

c. *Autobody Repair: Refinishing*, series of 6 filmstrips, 6 cassettes, and program guides

(NOTE: This series is available from Career Aids, Inc., 20417 Nordhoff Street, Dept. R, Chatsworth, California 91311, (800) 342-8200. The series contains filmstrips titled "Spraying Color," "Compounding and Polishing," "Masking, Priming, and Puttying." "Use and Care of the Spray Gun," "Paint Faults and How to Correct Them," and "Sanding Techniques, Tools and Materials.")

4. Filmstrip projector

5. Competency profiles

(NOTE: Competency profiles for this unit are available from the State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

C. Provide students with unit.

D. Introduce unit.

- Discuss unit and specific objectives, explaining that accomplishment of the specific objectives leads to attainment of the unit objective.
- Stress the importance of correctly mixing and applying automotive paint undercoats. Relate some of the consequences of improper mixing and application.
- Review Information Sheet, Section II, explaining that mixing and applying undercoats are steps in the total painting process.

E. Discuss information and job sheets.

1. Use Information Sheet, Section I, to introduce students to terms and definitions associated with automotive paint undercoats.

SUGGESTION:

- Show students examples to illustrate appropriate terms.

SUGGESTED ACTIVITIES

2. Use Information Sheet, Section III, to introduce students to the various types and uses of paint undercoats.

   SUGGESTIONS:

   - Show students different brands and samples of each type of product.
   - Explain the hazards related to each product.
   - Have the students read the directions and cautions on a variety of product labels and share this information with the class.
   - Outline uses and do's and don'ts for each product. Encourage students to take notes.
   - Make a bulletin board display of various product labels and uses.
   - Show appropriate filmstrips.

3. Use Information Sheet, Section IV, to introduce students to the four basic paint undercoats.

   SUGGESTION:

   - Explain the different types among these four basic groups. Stress the difference between primers and sealers.

4. Use Information Sheet, Sections V and VI to discuss primer-surfacers.

   SUGGESTIONS:

   - Give students hypothetical situations and ask them to tell what types of undercoats they would use.

     EXAMPLE: You are performing spot repair on an aluminum panel to receive a lacquer topcoat. The old topcoat is enamel. What types of undercoats should be applied?

   - Discuss the qualities of good primer-surfacer, explaining and demonstrating *holdout*, *adhesion* (or lack of it) and *settling resistance*.

5. Use Information Sheet, Sections VII and VIII to discuss reasons for applying sealer and guidelines for quality undercoating.

   SUGGESTIONS:

   - Explain the consequences of not following specific guidelines.
   - Show students examples of sand scratches that have swollen because sealer was not used.
   - Show students an example of a topcoat that has sunk into the substrate of an unsealed undercoat.

SUGGESTED ACTIVITIES

6. Discuss and demonstrate Job Sheets #1 through #4.

   SUGGESTION:

   - Assign completion dates and have the students complete the job sheets under your supervision.

F. Give test.

G. Critique test and discuss in class.

H. Complete appropriate section of competency profiles.

III. Unit references

A. Crouse, William H., and Donald L. Anglin. *Automotive Body Repair and Refinishing*, 2nd ed. New York: McGraw-Hill Book Company/Gregg Division, 1986.

B. Manual, Edward F., and Wayman R. Penner. *Auto Body Repair and Repainting*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, 1974.

C. Rhone, L. C., and H. David Yates. *Total Auto Body Repair*. 2nd ed. Indianapolis, Indiana: Bobbs-Merrill Educational Publishing, 1983.

MIXING AND APPLYING UNDERCOATS
UNIT IV

INFORMATION SHEET

I. Terms and definitions

A. Undercoat — Layers of paint material such as primer-surfacer, putty, and sealer used to provide a smooth, rust-free and corrosion-free base for topcoats

B. Adhesion — Ability of a substance to stick to a surface

C. Bleeding — Old color that comes through and colors or mars topcoat

D. Contaminants — Anything on surface to be painted that might harm or mar the finish

EXAMPLES: Polishes, waxes, dirt, tree sap, tar

E. Corrosion — Chemical reaction that results in deterioration of a metal

F. Flash off — First stage of drying during which some of the solvents evaporate, dulling the paint from a very high gloss

G. Holdout — Sealing quality of primer-surfacer that helps prevent topcoat from sinking into primer-surfacer

H. OEM finish — Original finish applied by the manufacturer

(NOTE: *OEM* stands for *original equipment manufacturer.*)

I. Settling — Process by which a primer-surfacer separates into its separate parts and, thus, does not spread uniformly

J. Substrate — Surface of material to be painted; may be old finish, an unpainted surface, a filled surface, or a combination of these surfaces

II. Sequence of steps in painting a vehicle

A. Vehicle is masked

B. Dust is blown out of crevices with compressed air

C. Area to be painted is wiped down with clean lint-free paper towels and tack rag

D. Bare metal is treated with metal conditioner and conversion coating

E. Primer coats are sprayed on

F. Guide coat is sprayed on and sanded

INFORMATION SHEET

G. Scratch putty (if used) is applied and surface is reprimed as necessary

H. Repair area is washed clean with water and detergent and remasked if necessary

I. Adhesion promoter (if used) is sprayed on

J. Sealer (if used) is sprayed on

K. Color coats are sprayed on

L. Clearcoat (if used) is sprayed on

III. Types of paint undercoat materials

A. Precleaner (wax and grease remover) — Material used to prepare vehicle surface for undercoating; removes all traces of wax, polish, and grease

(NOTE: A precleaner should be used even when the paint will be ground off. If the painted area is sanded before the wax or polish is removed, these materials will be ground into the surface, and the undercoat will not adhere to the substrate.)

B. Metal conditioner — Liquid chemical cleaner that provides a chemically clean bare metal surface by dissolving any microscopic rust or corrosion; also etches bare metal slightly for better adhesion of undercoat

C. Conversion coating (rust inhibitor) — Liquid chemical applied after metal conditioner to provide proper bonding surface for undercoat and to inhibit formation of rust and corrosion

(NOTE: Some manufacturers market a product that is a combination metal conditioner and conversion coating.)

D. Primer — First undercoat in finish system; prevents rust and corrosion and improves adhesion of topcoat

(NOTE: Straight primer is not used very often today because it does not fill or cover small imperfections in the surface to be painted.)

E. Primer-surfacer — Primer to which a special material has been added so that it will fill minor surface imperfections, as well as prevent rust and corrosion

F. Primer-sealer — Material that provides same protection as primer, but in addition provides a barrier film between undercoat and topcoat

G. Guide coat — Contrasting light-mist coat sprayed on after primer-surfacer has been applied; when surface is sanded, contrast shows up surface imperfections

H. Putty — Thick paste used after priming to fill minor surface imperfections that were not filled with primer-surfacer

INFORMATION SHEET

I. Sealer — Material applied over primer, primer-surfacer, or sanded old finish to provide a barrier film between undercoat and topcoat

(NOTE: Sealers differ from primer-sealers in that they cannot be used as primers.)

EXAMPLE: If an enamel topcoat will be applied over lacquer, a sealer must first be used to prevent the lacquer from bleeding through the enamel and giving the topcoat a spotty appearance.

J. Adhesion promoter — Sealer containing special properties that promote adhesion

K. Final cleaner — Fast-drying material used for cleaning rubbing compound oil, fingerprints, sanding dust, and sludge from surface just before application of topcoat

L. Rubbing compound — Abrasive paste (coarser than polishing compound) that smooths and etches paint film and brings out a high gloss

(NOTE: Rubbing compound comes in hand and machine grits. Hand rubbing compound contains fairly coarse pumice grit and is used primarily for small repair areas. Machine rubbing compound contains fine particles of pumice and is designed for use with a power polisher for large repairs. Hand compound should not be used with the power polisher as the coarse particles would create too much heat and friction.)

IV The four basic paint undercoats

A. Primers

(NOTE: Primers are usually enamel- or epoxy-type products because they provide better adhesion and corrosion resistance than lacquers.)

B. Primer-surfacers

(NOTE: There are three types of primer-surfacers: 1) nitrocellulose lacquer, 2) alkyd enamel, and 3) acrylic lacquer. Nitrocellulose primer-surfacer is commonly used because it dries fast and is easy to sand; however, it does not have the rust and corrosion resistance of the other two primer-surfacers, and its use is limited to small repair areas. Alkyd primer-surfacer provides rust and corrosion resistance, but it is slow drying. Acrylic lacquer primer-surfacer combines the fast drying quality of nitrocellulose with the durability of the enamel-based primer-surfacer.)

C. Primer-sealers

D. Sealers

INFORMATION SHEET

V. Factors to consider when choosing a paint undercoat

(NOTE: The following factors determine whether the technician uses a primer, a primer-sealer, or a primer-surfacer by itself or in combination with scratch putty and sealer.)

A. Composition of substrate

EXAMPLES: Steel, aluminum, galvanized metal, urethane plastic, fiberglass

B. Condition of substrate

EXAMPLES: Smooth, rough, bare, painted, filled

C. Type of substrate finish

EXAMPLES: Enamel paint, acrylic paint

D. Type of topcoat to be used

EXAMPLE: Lacquer topcoat over enamel primer-surfacer

VI. Qualities of a good primer-surfacer

A. Provides holdout

B. Adheres well to substrate

C. Fills minor surface imperfections

D. Resists settling

E. Is easily sanded

F. Is fast drying

VII. Reasons for applying sealer

A. To help a light color hide a dark color when vehicle will be repainted a different color or when primer-surfacer is darker than selected topcoat color

B. To help reduce sand-scratch swelling

(NOTE: Sand-scratch swelling can occur when sealer is not used between old and new topcoats. The solvent in the new topcoat softens the edges of sand scratches in the old topcoat, making them swell.)

C. To provide uniform, even holdout and thus prevent new topcoat from sinking into substrate made up of different types of paint such as primer-surfacer or old topcoat

D. To ensure good adhesion between old and new topcoats (Table 1)

INFORMATION SHEET

TABLE 1: Sealer Application to Improve Adhesion

Coat application	Sealer recommendation
Alkyd enamel over lacquer	Sealer *must* be used
Enamel over enamel	Adequate adhesion may be present between the two coats, but there is no guarantee, so sealer *should* be used
Lacquer over enamel	Spot repairs are not a problem, but a sealer is *recommended*, especially in panel repair or complete repainting
Lacquer over lacquer	Sealer is *not required but may be desired* for holdout and hiding sand scratches

VIII. Guidelines for quality undercoating

A. Check condition of old paint surface to determine whether old surface paint is adhering well and is not rusting

(NOTE: To test adhesion, sand through the finish and featheredge a small spot. If the thin paint edge does not break or crumble, it is safe to assume that the old paint will stay on when the refinish color is applied.)

B. Make sure that *all* wax, grease, and other contaminants are removed from the surface to be undercoated

C. Avoid the habit of rubbing your hand over an area to determine the effects of sanding

(NOTE: The skin oil from your hands will be transferred to the vehicle surface and can ruin the paint job.)

D. Wash vehicle only with nonpetroleum-based detergents

(NOTE: Petroleum-based detergents contain oils that will create paint problems later.)

E. Never prime over bare metal that has not been treated with metal conditioner and conversion coating

F. Sand in one direction, and always use a block or pad when hand sanding to avoid finger marks and uneven sanding

G. Never apply lacquer over an unsealed enamel coat

(NOTE: The lacquer thinner penetrates the enamel coat and causes it to swell and show through the lacquer coat.)

H. Spray two or three coats of primer-surfacer rather than one thick coat

INFORMATION SHEET

I. Choose the correct products for the job and apply these products in correct sequence

J. Read and follow manufacturer's recommendations as to gun distance, mix proportions, spray pattern, number of coats, gun angle, rate of stroke, and required drying time

K. Choose the correct reducer or thinner for shop conditions and for type of undercoat and desired topcoat

MIXING AND APPLYING UNDERCOATS
UNIT IV

JOB SHEET #1 — MIX AND APPLY ACRYLIC LACQUER PRIMER-SURFACER, GUIDE COAT, AND SEALER

I. Equipment and materials

A. Acrylic lacquer primer-surfacer

B. Guide coat of color contrasting primer-surfacer

C. Wax and grease remover

D. Final cleaner

E. Thinner

F. Stirring paddles and strainer

G. Viscosity cup

H. Paint gun and cups

I. Tack rags

J. Proper-grit sandpapers and sanding block or pad

K. Scratch putty and rubber squeegee

L. Blow gun

M. Eye protection

N. OSHA-approved respirator

(NOTE: Always use an OSHA-approved respirator with a new cartridge. The vapor from catalyzed paint contains isocyanates, which can be very harmful to your lungs. Isocyanate breaks down the charcoal filter cartridges; therefore, the cartridges must be changed frequently.)

O. Vehicle that has been masked and washed with final cleaner

II. Procedure

A. Inspect vehicle to make sure that it is properly masked, washed, and ready for undercoating

(NOTE: If vehicle was pushed into paint booth, be sure to clean off oily handprints with final cleaner.)

JOB SHEET #1

B. Put on eye protection and respirator

C. Mix lacquer primer-surfacer to recommended percentage, following all label instructions and cautions

D. If making a spot repair, perform the following steps and then proceed to Step F

1. Strain mixed primer-surfacer into spray gun cup

2. Adjust spray gun to correct spray pattern and adjust pressure at gun to that recommended by primer-surfacer manufacturer

3. Apply first coat to inside of featheredge as shown in Figure 1; let flash off for recommended length of time

FIGURE 1

4. Apply second coat a little beyond first coat, allow to flash off, and then apply each successive coat a little beyond preceeding one

5. Continue applying recommended number of coats, allowing each to flash off before applying the next, until primer-surfacer is built to level of original paint as shown in Figure 1

E. If applying primer-surfacer to complete body sections, perform the following steps

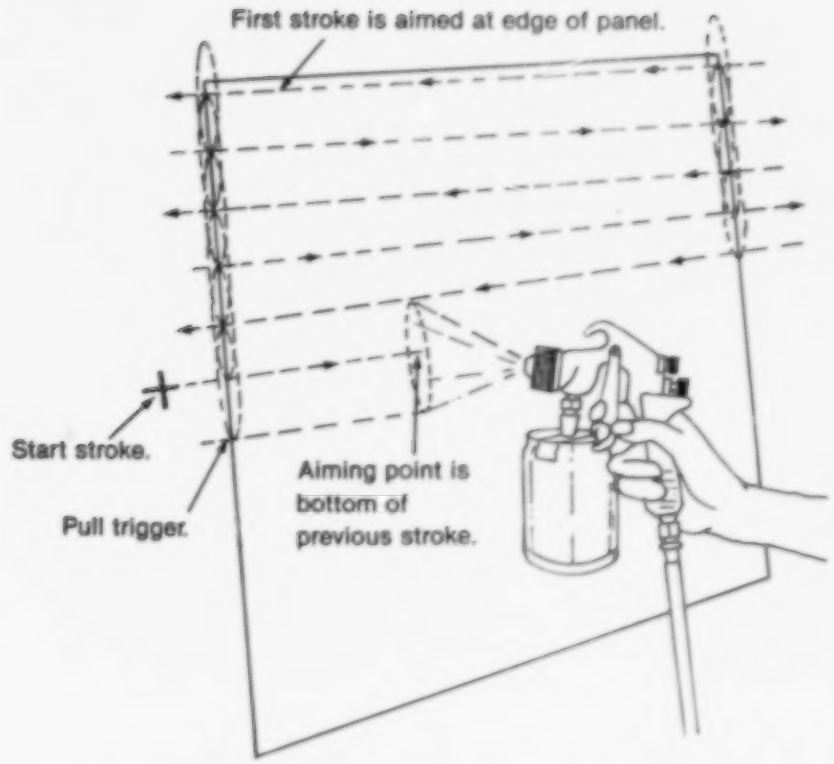
1. Strain mixed primer-surfacer into spray gun cup

2. Adjust spray gun to correct pattern, and adjust pressure at gun to that recommended by primer-surfacer manufacturer

3. Using alternate right and left strokes, and triggering gun at beginning and end of each stroke, apply recommended number of double-wet coats, overlapping each one-half of previous stroke as shown in Figure 2 and allowing each coat to flash off for recommended length of time before applying next one

JOB SHEET #1

FIGURE 2



4. Allow primer-surfacer to dry for length of time recommended by manufacturer

F. Mix guide coat according to manufacturer's specifications and strain into paint gun cup

G. Spray a light guide coat over entire repair area

(NOTE: Guide coat is applied so that sand scratches will show during sanding. Traces of contrasting guide coat will lie in these scratches. If the sanded guide coat reveals scratches, they may be smoothed with scratch putty.)

H. Lightly sand repair area with appropriate-grit sandpaper

I. Blow clean with compressed air and wipe with tack cloth

J. Reprime and reguidecoat if necessary

K. Use squeegee to apply scratch putty (if recommended) to any minor nicks or chips in surface of primer-surfacer

JOB SHEET #1

L. Block-sand area

1. If topcoat is to be lacquer, block-sand with #400-grit sandpaper
2. If topcoat is to be enamel, block-sand with #320-grit sandpaper

M. Use blow gun to blow sanding dust from surface, cracks, and trim

N. Wipe sanded area with tack cloth

O. Wash area with final cleaner, wiping cleaner off before it dries

P. Apply sealer

1. Mix sealer and correct reducer according to manufacturer's instructions
2. Strain mixture into paint cup
3. Set spray gun air pressure at gun to that recommended by sealer manufacturer
4. Apply an even, medium coat of sealer
5. Allow sealer to dry for at least 15 minutes, but less than 1 hour
6. Wipe sealed area with tack rag

(NOTE: The vehicle is now prepared for its topcoat. Do not allow the sealer to remain on the undercoat too long before applying the topcoat. Generally, the topcoat should be applied within 1 hour after sealer. See appropriate job sheet in Unit V for correct topcoating procedure.)

MIXING AND APPLYING UNDERCOATS
UNIT IV

JOB SHEET #2 — MIX AND APPLY NONSANDING ENAMEL PRIMER-SEALER

I. Equipment and materials

A. Nonsanding enamel primer-sealer

B. Reducer

C. Stirring paddles and strainer

D. Viscosity cup

E. Paint gun and cups

F. Tack rags

G. Proper-grit sandpapers and sanding block or pad

H. Air gun

I. Wax and grease remover

J. Final cleaner

K. Eye protection

L. OSHA-approved respirator

(NOTE: Always use an OSHA-approved respirator with a new cartridge. The vapor from catalyzed paint contains isocyanates, which can be very harmful to your lungs. Isocyanate breaks down the charcoal filter cartridges; therefore, the cartridges must be changed frequently.)

M. Guidecoat of color contrasting that of primer-sealer

N. Vehicle that has been masked and washed with final cleaner

II. Procedure

A. Inspect vehicle to make sure that it is properly masked, washed, and ready for undercoating

(NOTE: If vehicle was pushed into paint booth, be sure to clean off oily handprints with final cleaner.)

JOB SHEET #2

B. Put on eye protection and respirator

C. Mix enamel primer-sealer according to label instructions and cautions

D. Strain mixed primer-sealer into spray gun cup, and adjust gun pressure and spray pattern to that recommended by primer-sealer manufacturer

E. Apply recommended type and number of coats, allowing each coat to flash off for length of time recommended by manufacturer before applying next coat

F. Let primer-sealer dry according to manufacturer's specifications

(NOTE: Nonsanding enamel primer-sealer may be lightly scuffed with #400-grit sandpaper if necessary to remove nibs and specks.)

G. Mix and apply guide coat (Job Sheet #1)

H. Lightly sand guide-coated area with appropriate-grit sandpaper

I. Blow area clean with compressed air and wipe with tack rag

J. Reprime and reguidecoat if necessary

K. Wash area with final cleaner, wiping cleaner off before it dries

(NOTE: The vehicle is now ready for its topcoat. An epoxy or lacquer-type topcoat must be used on a vehicle undercoated with enamel primer-sealer. See appropriate job sheet in Unit V for correct topcoating procedure.)

MIXING AND APPLYING UNDERCOATS
UNIT IV

JOB SHEET #3 — MIX AND APPLY EPOXY PRIMER

I. Equipment and materials

A. Epoxy primer and activator

B. Stirring paddle

C. Viscosity cup

D. Paint gun

E. Strainer

F. Thinner

G. Eye protection

H. OSHA-approved respirator

(NOTE: Always use an OSHA-approved respirator with a new cartridge. The vapor from catalyzed paint contains isocynates, which can be very harmful to your lungs. Isocynate breaks down the charcoal filter cartridges; therefore, the cartridges must be changed frequently.)

I. Final cleaner

J. Vehicle that has been masked and washed with final cleaner

II. Procedure

A. Inspect vehicle to be sure that it is properly masked, washed, and ready for undercoating

(NOTE: If the vehicle was pushed into paint booth, be sure to clean off oily handprints with final cleaner.)

B. Put on eye protection and respirator

C. Mix epoxy primer with activator according to label instructions and cautions

D. Stir thoroughly

E. Wait for recommended length of time before using

(NOTE: Epoxy primer and activator require a specific induction period before the components have been activated and are ready for use. Read and follow label instructions carefully.)

JOB SHEET #3

F. Strain primer into paint gun cup

G. Apply one or two full wet coats at recommended gun pressure

H. If second coat is applied, allow first coat to flash off for specified length of time

I. Allow final coat to air dry for length of time recommended by manufacturer before applying other undercoatings or topcoats

J. Clean equipment with thinner

K. Clean work area and return equipment and materials to proper storage

MIXING AND APPLYING UNDERCOATS
UNIT IV

JOB SHEET #4 — PRIME AND SEAL A REPLACEMENT PANEL

I. Equipment and materials

A. Drill motor and assorted drills

B. Wax and grease remover

C. Final cleaner

D. Bucket and Tide or other nonpetroleum-based detergent

E. Air gun

F. Clean, lint-free cloths or paper towels

G. Appropriate-grit sandpapers and sanding block or pad

H. Metal conditioner

I. Conversion coating

J. Primer-surfacer

K. Stirring paddles and strainer

L. Viscosity cup

M. Paint gun and cups

N. Guide coat of color contrasting primer-surfacer

O. Scratch putty

P. Sealer

Q. Tack rag

R. Eye protection

S. OSHA-approved respirator

(NOTE: Always use an OSHA-approved respirator with a new cartridge. The vapor from catalyzed paint contains isocyanates, which can be very harmful to your lungs. Isocyanate breaks down the charcoal filter cartridges; therefore, the cartridges must be changed frequently.)

T. Rubber gloves and rubber apron

U. Service manual

JOB SHEET #4

II. Procedure

A. Determine how panel will be attached to vehicle

(NOTE: If panel will be bolted to vehicle—such as a complete door or front fender—then it is usually edged-in off the vehicle before being installed. If the panel must be brazed or spot welded to the body, such as a quarter panel—it should first be attached to the vehicle and then painted. This job sheet covers the procedure for undercoating the panel off the vehicle.)

B. Put on eye protection

C. Drill trim holes if necessary

(NOTE: It is a good idea to drill these holes before the panel is painted. The edges of the holes will then be covered with conditioner and primer to prevent rust under the trim.)

D. Put on rubber gloves, apron and respirator

E. Wash panel with detergent and water; blow dry

F. Wash panel with wax and grease remover and clean cloth, following directions and cautions on remover label

G. Wipe off remover with another clean cloth before it dries

(NOTE: If remover dries on the panel, rewet it and then wipe it off before it dries.)

H. Block-sand panel with proper-grit sandpaper, paying special attention to any imperfections in the OEM finish

I. Blow clean and wipe with tack rag

J. Treat with metal conditioner and conversion coating any bare metal places left by sanding process, following instructions and cautions on labels

K. Wipe cleaner off panel before it dries

L. Determine type of primer-surfacer to use

M. Mix primer-surfacer and thinner or reducer according to manufacturer's instructions

N. Strain primer-surfacer into paint gun cup

JOB SHEET #4

O. Apply recommended number of coats of primer-surfacer to bare metal area treated with metal conditioner and conversion coating

(NOTE: The most commonly prepared metal panels are new steel replacement panels. Most of these steel panels are sprayed at the factory with a coat of primer to help prevent rust before the panel is installed on the vehicle. Normally, this factory primer is a good base for topcoat and does not require an additional primer coat.)

P. Allow primer-surfacer to dry thoroughly

Q. Apply guide coat (Job Sheet #1)

R. Lightly sand guide coat with appropriate-grit sandpaper

S. Blow clean with compressed air and wipe with tack rag

T. Inspect sanded area for any small nicks or defects; if there are any, fill them with scratch putty if recommended

U. Block-sand, clean, and reprime any spot-puttied areas of panel

V. Resand, blow clean, and tack any reprimed areas

W. Apply correct sealer to panel surface, following directions and cautions on sealer label (Job Sheet #2)

X. Install panel on vehicle

Y. Wash panel with final cleaner, making sure to wipe off cleaner before it dries

(NOTE: The panel is now properly finished for the topcoat. Do not allow the sealer to remain on the undercoat too long before applying the topcoat. Generally the topcoat should be applied within 1 hour after the sealer is applied. See appropriate job sheet in Unit V for topcoating procedure.)

MIXING AND APPLYING UNDERCOATS
UNIT IV

TEST

NAME _____ SCORE _____

1. Match to their correct definitions terms associated with automotive paint undercoats. Write the correct numbers in the blanks.

_____a. Process by which a primer-surfacer separates into its separate parts and, thus, does not spread uniformly

_____b. Ability of a substance to stick to a surface

_____c. Chemical reaction that results in deterioration of a metal

_____d. Original finish applied by the manufacturer

_____e. Old color that comes through and colors or mars the topcoat

_____f. Layers of paint material such as primer-surfacer, putty, and sealer used to provide a smooth, rust-free and corrosion-free base for topcoats

_____g. Sealing quality of a primer-surfacer that helps prevent topcoat from sinking into primer-surfacer

_____h. Anything on surface to be painted that might harm or mar the finish

_____i. First stage of drying during which some of the solvents evaporate, dulling the paint from a very high gloss

_____j. Surface of material to be painted; may be old finish, an unpainted surface, a filled surface, or a combination of these surfaces

1. Undercoat
2. Bleeding
3. Adhesion
4. OEM finish
5. Contaminants
6. Corrosion
7. Settling
8. Holdout
9. Flash off
10. Substrate

2. Arrange in order the sequence of steps in painting a vehicle. Write a "1" before t step, a "2" before the second step, and so on.

_____a. Area to be painted is wiped down with clean, lint-free paper towels and tack rag

_____b. Vehicle is masked

_____c. Clearcoat (if used) is sprayed on

_____d. Guide coat is sprayed on and sanded

_____e. Bare metal is treated with metal conditioner and conversion coating

_____f. Scratch putty (if used) is applied and surface is reprimed as necessary

_____g. Color coats are sprayed on

_____h. Dust is blown out of crevices with compressed air

_____i. Adhesion promoter (if used) is sprayed on

_____j. Repair area is washed with clean water and detergent and remasked if necessary

_____k. Primer coats are sprayed on

_____l. Sealer (if used) is sprayed on

3. Select correct descriptions of paint undercoat materials. Write the correct numbers in the blanks.

_____a. Precleaner (wax and grease remover)

1. Liquid chemical cleaner that provides a chemically clean bare metal surface by dissolving any microscopic rust or corrosion; also etches bare metal slightly for better adhesion of undercoat

2. First undercoat is finish system; prevents rust and corrosion and improves adhesion of topcoat

3. Material used to prepare vehicle surface for undercoating; removes all traces of wax, polish, and grease

_____b. Metal conditioner

1. Liquid chemical cleaner that provides a chemically clean bare metal surface by dissolving any microscopic rust or corrosion; also etches bare metal slightly for better adhesion or undercoat

2. Material that provides same protection as primer, but in addition provides a barrier film between undercoat and topcoat

3. Contrasting light-mist coat sprayed on after primer-surfacer has been applied; when surface is sanded contrast shows up surface imperfections

TEST

_____c. Conversion coating (rust inhibitor)

1. Liquid chemical applied after metal conditioner to provide proper bonding surface for undercoat and to inhibit formation of rust and corrosion

2. Liquid chemical cleaner that provides a chemically clean bare metal surface by dissolving any microscopic rust or corrosion; also etches bare metal slightly for better adhesion of undercoat

3. Primer to which a special material has been added so that it will fill minor surface imperfections, as well as prevent rust and corrosion

_____d. Primer

1. Contrasting light-mist coat sprayed on after primer-surfacer has been applied; when surface is sanded contrast shows up surface imperfections

2. First undercoat in finish system; prevents rust and corrosion and improves adhesion of topcoat

3. Material used to prepare vehicle surface for undercoating; removes all traces of wax, polish, and grease

_____e. Primer-surfacer

1. Material applied over primer, primer-surfacer, or sanded old finish to provide a barrier film between undercoat and topcoat

2. Material that provides same protection as primer, but in addition provides a barrier film between undercoat and topcoat

3. Primer to which special material has been added so that it will fill minor surface imperfections, as well as prevent rust and corrosion

_____f. Sealer

1. Material applied over primer, primer-surfacer, or sanded old finish to provide a barrier film between undercoat and topcoat

2. Primer to which special material has been added so that it will fill minor surface imperfections, as well as prevent rust and corrosion

3. Thick paste used after priming to fill minor surface imperfections that were not filled with primer-surfacer

TEST

_____g. Adhesion promoter

1. Sealer containing special properties that promote adhesion
2. First undercoat in finish system; prevents rust and corrosion and improves adhesion of topcoat
3. Material used to prepare vehicle surface for undercoating; removes all traces of wax, polish, and grease

_____h. Primer-sealer

1. Material that provides same protection as primer, but in addition provides a barrier film between undercoat and topcoat
2. Primer to which special material has been added so that it will fill minor surface imperfections, as well as prevent rust and corrosion
3. Material applied over primer, primer-surfacer, or sanded old finish to provide a barrier film between undercoat and topcoat

_____i. Guide coat

1. First undercoat in finish system; prevents rust and corrosion and improves adhesion of topcoat
2. Primer to which a special material has been added as contrast; contrast in texture helps painter by showing up surface imperfections
3. Contrasting light-mist coat sprayed on after primer-surfacer has been applied; when surface is sanded contrast shows up surface imperfections

_____j. Putty

1. Thick paste used before priming to fill minor surface imperfections that were not filled with conversion coating
2. Thick paste used after priming to fill minor surface imperfections that were not filled with primer-surfacer
3. Abrasive paste (coarser than polishing compound) that smooths and etches paint film and brings out high gloss

TEST

_____k. Rubbing compound

1. Thick paste used before priming to fill minor surface imperfections that were not filled with conversion coating
2. Polishing compound (finer than abrasive paste) that smooths and etches paint film and brings out high gloss
3. Abrasive paste (coarser than polishing compound) that smooths and etches paint film and brings out high gloss

_____l. Final cleaner

1. Liquid chemical cleaner that provides a chemically clean bare metal surface by dissolving microscopic rust or corrosion
2. Fast-drying material used for cleaning rubbing compound oil, fingerprints, sanding dust and sludge from surface just before application of topcoat
3. Material used to prepare vehicle surface for undercoating; removes all traces of wax, polish, and grease

4. List the four basic paint undercoats.

a. _____

b. _____

c. _____

d. _____

5. Discuss factors to consider when choosing a paint undercoat.

_____

_____

_____

_____

6. List four qualities of good primer-surfacer.

a. _____

b. _____

c. _____

d. _____

TEST

7. Discuss reasons for applying sealer.

_____

_____

_____

_____

8. Select from the following list guidelines for quality undercoating. Write an "X" in the blank before each correct guideline.

_____a. Wash vehicle thoroughly with petroleum-based detergent

_____b. Check condition of old paint surface to determine whether old surface paint is adhering well and is not rusting

_____c. Make sure that most wax, grease, and other contaminants are removed from surface to be undercoated

_____d. Never apply enamel over unsealed lacquer coat

_____e. Rub your hand over a sanded area to determine the effects of sanding

_____f. Sand in one direction, and always use a block or pad when hand sanding to avoid finger marks and uneven sanding

_____g. Read and follow manufacturer's directions as to gun distance, mix proportions, spray pattern, number of coats, gun angle, rate of stroke, and required drying time

_____h. Always prime over bare metal that has not been treated with metal conditioner and conversion coating

_____i. Choose the correct reducer or thinner for shop conditions and for type of undercoat and desired topcoat

_____j. Spray one thick coat of primer-surfacer rather than two or three coats

_____k. Choose the correct products for the job and apply these products in the correct sequence

(NOTE: Test item 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Mix and apply acrylic lacquer primer-surfacer, guide coat, and sealer.

   b. Mix and apply nonsanding enamel primer-sealer.

   c. Mix and apply epoxy primer.

   d. Prime and seal a replacement panel.

MIXING AND APPLYING UNDERCOATS
UNIT IV

ANSWERS TO TEST

1.
a.	7	f.	1
b.	3	g.	8
c.	6	h.	5
d.	4	i.	9
e.	2	j.	10

2.
a.	3	g.	11
b.	1	h.	2
c.	12	i.	9
d.	6	j.	8
e.	4	k.	5
f.	7	l.	10

3.
a.	3	g.	1
b.	1	h.	3
c.	1	i.	2
d.	2	j.	2
e.	3	k.	3
f.	1	l.	2

4.
a. Primers
b. Primer-surfacers
c. Primer-sealers
d. Sealers

5. Discussion should include the following

a. Composition of substrate
b. Condition of substrate
c. Type of substrate finish
d. Type of topcoat to be used

6. Answer should include any four of the following

a. Provides holdout
b. Adheres well to substrate
c. Fills minor surface imperfections
d. Resists settling
e. Is easily sanded
f. Is fast drying

ANSWERS TO TEST

7. Discussion should include the following

   a. To help a light color hide a dark color when vehicle will be repainted a different color or when primer-surfacer is darker than selected topcoat color
   b. To help reduce sand-scratch swelling
   c. To provide uniform, even holdout and thus prevent new topcoat from sinking into substrate made up of different types of paint such as primer-surfacer or old topcoat
   d. To ensure good adhesion between old and new topcoats

8. b, f, g, i, k

9. Performance skills evaluated to the satisfaction of the instructor

MIXING AND APPLYING TOPCOATS
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to mix and apply automotive paint topcoats. The student will show this knowledge by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with automotive paint topcoats.
2. Match basic paint ingredients to their correct descriptions.
3. Name types of finishes used on today's vehicles.
4. State facts about acrylic enamel and acrylic lacquer paints.
5. State facts about types of enamel paints.
6. Select correct descriptions of coat application techniques.
7. Describe degrees of coat thickness of sprayed paint.
8. Select causes of common paint application problems.
9. List guidelines for preventing dirty paint.
10. Demonstrate the ability to
    a. Color match and apply metallic paint.
    b. Color match paint and perform a spot repair.
    c. Paint a panel.
    d. Perform a complete paint job.
    e. Repair water-based acrylic enamel.
    f. Repair a clearcoat.

MIXING AND APPLYING TOPCOATS
UNIT V

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Transparencies

1. TM #1 — External and Internal Spray Gun Mix

2. TM #2 — Paint Problems From Improper Handling of Paint Gun

D. Information sheet

E. Student Supplement #1 — Troubleshooter's Guide for Finish Problems

F. Job sheets

1. Job Sheet #1 — Color Match and Apply Metallic Paint

2. Job Sheet #2 — Color Match Paint and Perform a Spot Repair

3. Job Sheet #3 — Paint a Panel

4. Job Sheet #4 — Perform a Complete Paint Job

5. Job Sheet #5 — Repair Water-Based Acrylic Enamel

6. Job Sheet #6 — Repair a Clearcoat

G. Test

H. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Order or obtain equipment and materials needed to teach unit.

1. Equipment and materials for job sheet performance

2. Samples of topcoat paint (factory packaged, on color chips, and applied to vehicles)

SUGGESTED ACTIVITIES

3. Color chip books for student reference when color matching

4. Paint booklets from major automotive paint manufacturers

5. Filmstrips

   (NOTE: The following filmstrips are available from Teaching Aids, Incorporated, Post Office Box 1798, Costa Mesa, California 92628-0798.)

   a. *Acrylic Lacquer Refinishing*, 1 filmstrip (57 frames), 1 cassette, 1 work sheet

   b. *Synthetic Enamel Refinishing*, 1 filmstrip (41 frames), 1 cassette, 1 work sheet

   c. *Acrylic Enamel Refinishing*, 1 filmstrip (40 frames), 1 cassette, 1 work sheet

   d. *Painting a Complete Automobile*, 1 filmstrip (45 frames), 1 cassette, 1 work sheet

   e. *Painting*, 1 filmstrip (35 frames), 1 cassette, 1 work sheet

      (NOTE: This filmstrip demonstrates the use of the paint gun, pattern settings, and spraying techniques. It covers the use of alkyd resin enamels and acrylic lacquer, and illustrates spot painting and complete paint jobs.)

   f. *Paint Problems*, 1 filmstrip (34 frames), 1 cassette, 1 work sheet

      (NOTE: This filmstrip covers the basic paint problems outlined in Supplement #1—blistering, wrinkling, water spots, blushing, bleeding, etc.—and presents their cures.)

6. Transparencies and competency profiles

   (NOTE: Transparencies and competency profiles for this manual are available from the State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

7. Unit IV ("Mixing and Applying Undercoats") of this manual

   (NOTE: It is suggested that Units IV and V be taught in close sequence. Unit V brings closure to painting procedures begun in Unit IV.)

C. Provide students with unit.

SUGGESTED ACTIVITIES

D. Introduce unit.

SUGGESTIONS:

- Discuss unit and specific objectives. Explain how completion of the specific objectives leads to accomplishment of the unit objective.
- Stress safety pertinent to painting. Discuss the dangers associated with urethane paints that contain isocyanates. Review the use of respirators, proper safety equipment, and protective clothing.
- Explain that various degrees of skill are required for different paint topcoats and techniques, and that the skilled refinisher has learned through much practice and trial and error.

E. Discuss information and job sheets.

1. Use Information Sheet, Section I to introduce students to terms associated with mixing and applying topcoats.
2. Use Information Sheet, Section II to discuss the basic ingredients common to all automotive paints.

   SUGGESTION:

   - Show students examples where applicable.
3. Use Information Sheet, Section III and the booklets obtained from paint manufacturers to discuss and explain the types of finishes found on today's vehicles.

   SUGGESTIONS:

   - Provide students with a copy of Student Supplement #1 found at end of manual. Discuss section titled "History of Automotive Finishes."
   - Provide students with samples of the different types of finishes. Have them read the application instructions and cautions on the product labels. Quiz them orally on their products.
4. Use Information Sheet, Sections, IV and V to discuss enamels and lacquers.

   SUGGESTIONS:

   - Discuss the advantages and disadvantages of each paint type.

SUGGESTED ACTIVITIES

- Show filmstrips *Acrylic Lacquer Refinishing*, *Synthetic Enamel Refinishing*, and *Acrylic Enamel Refinishing*. Critique filmstrips and discuss with the class.

- Take students on a field trip to an automotive paint store so that they may inventory the paint products available on today's market.

5. Use Information Sheet, Sections VI and VII to discuss coat application techniques.

   SUGGESTIONS:

   - Show filmstrip *Painting*. Critique and discuss with the class.

   - Demonstrate each of the techniques outlined in Section VI.

   - Allow students to practice each of the outlined techniques until they become proficient.

   - Have students practice spraying paint to the various coat thicknesses outlined in Section VII.

   - Illustrate spray gun mixes with Transparency #1.

6. Use Information Sheet, Section VIII to introduce students to common paint application problems.

   SUGGESTIONS:

   - Show filmstrip *Paint Problems*. Critique and discuss with the class.

   - Review and discuss paint problems illustrated in Student Supplement #1.

   - Show students actual examples of as many problems as possible.

7. Use Information Sheet, Section IX to discuss guidelines for preventing dirty paint.

   SUGGESTIONS:

   - Demonstrate how to fold and use tack rag for maximum dust pickup.

   - Demonstrate how static electricity attracts dust.

   - Review process for cleaning paint gun and nozzles as outlined in Unit I, Job Sheet #2.

SUGGESTED ACTIVITIES

8. Discuss and demonstrate Job Sheets #1 through #6. Assign completion dates, and have students complete the job sheets under your supervision.

   SUGGESTION:

   - Allow students plenty of practice so that they may perfect their spraying techniques.

F. Give test.

G. Critique test and discuss with the class.

H. Complete appropriate section of the competency profiles.

III. Unit references

A. Crouse, William H., and Donald L. Anglin. *Automotive Body Repair and Refinishing*, 2nd ed. New York: McGraw-Hill Book Company/Gregg Division, 1986.

B. *Ditzler Automotive Finishes*. Troy, Michigan: PPG Industries, Inc., 1982.

C. *DuPont Refinish Shop Manual*. Wilmington, Delaware: E.I. DuPont DeNemours & Co., Incorporated, 1986.

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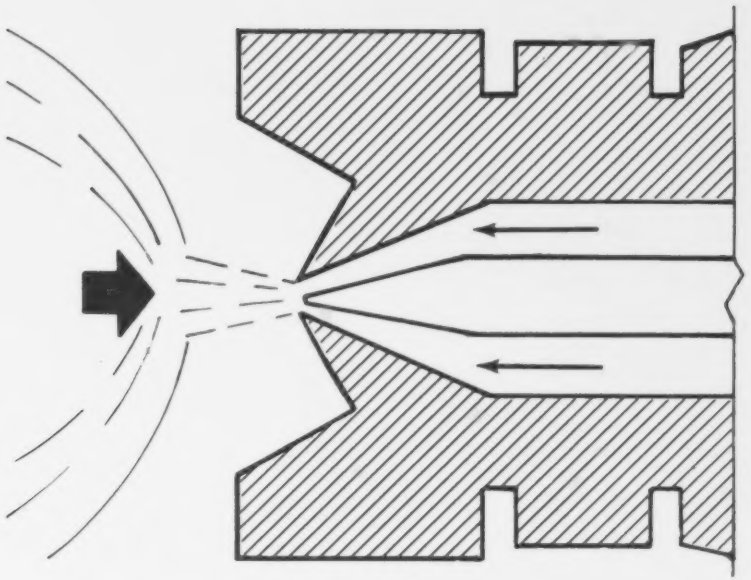
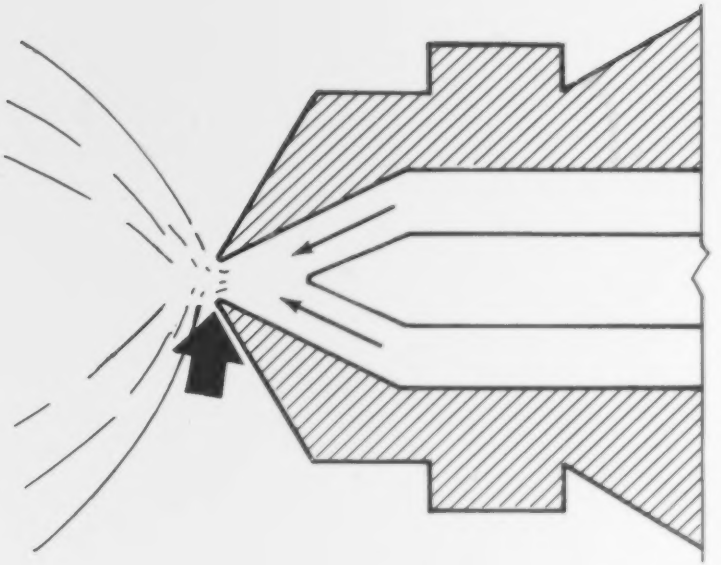
E. Rhone, L.C., and H. David Yates. *Total Auto Body Repair*. 2nd ed. Indianapolis, Indiana: Bobbs-Merrill Educational Publishing, 1983.

External and Internal Spray Gun Mix

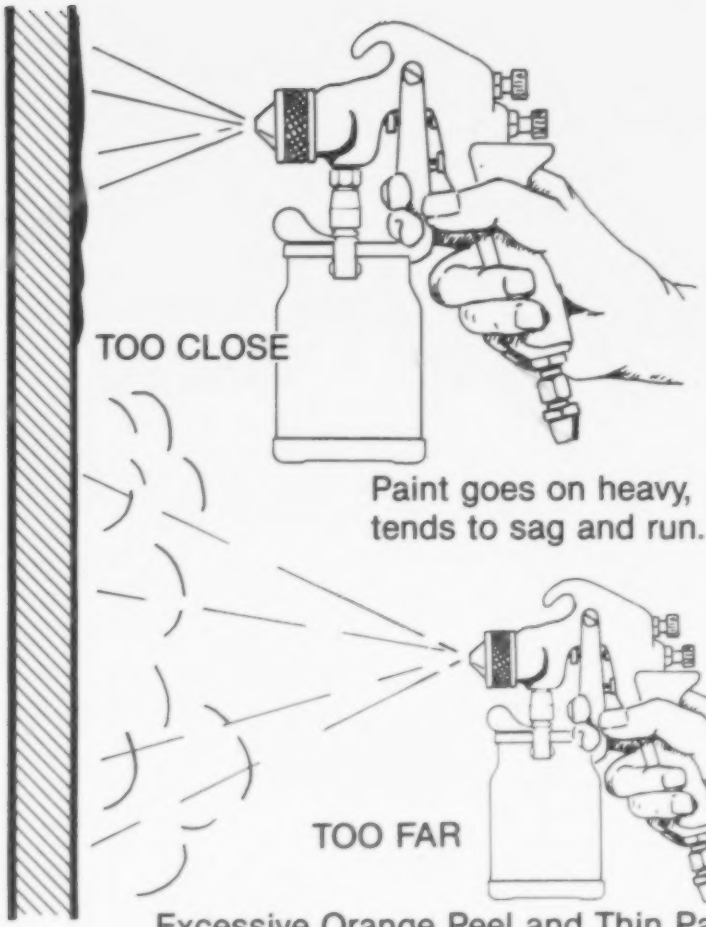


External Mix

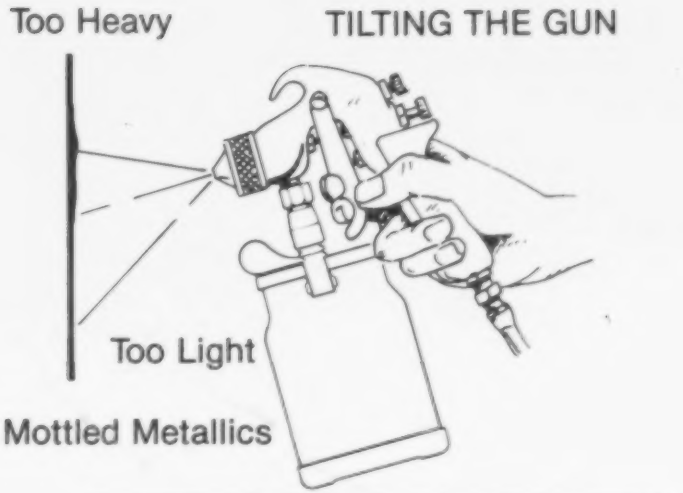


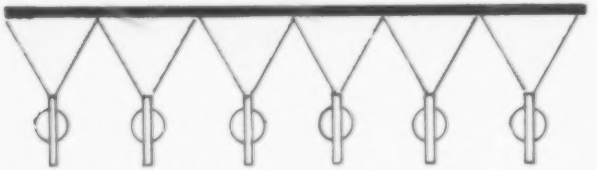
Internal Mix

Paint Problems from Improper Handling of Paint Gun



Excessive Orange Peel and Thin Paint Film





Keep gun parallel to surface.

Do not arc gun.

MIXING AND APPLYING TOPCOATS
UNIT V

INFORMATION SHEET

I. Terms and definitions

A. Topcoat — Final layers of paint materials, such as lacquers or enamels, used to give automobile color and corrosion resistance

B. Bleeding — Paint defect in which old color seeps through paint topcoat

C. Blending (melt-in) — Combining and integrating various paint coats

D. Clearcoat — Transparent topcoating applied over colorcoat to provide gloss and durability

E. Compounding — Hand- or machine-rubbing of painted surface until it acquires high gloss or luster

F. Curing — The drying and hardening time for paint

G. Drier — Paint additive that speeds paint drying or curing time

H. Dry spray — Small amount of paint in relation to spray gun air pressure; results in a light, thin dry paint film

I. Factory package — Paint mixed and sealed in a can by paint manufacturer

J. Film — Actual thickness of paint on a surface

K. Flow-out — Self-leveling process of newly applied paint

L. Luster (gloss) — Shine or glow exhibited by painted surface

M. Mass tone — Color of paint as it appears in can

N. Metallic — Small particles of ground-up metal used in combination with paint; also paint containing such particles

(NOTE: Some manufacturers today are using small particles of mica, a mineral, to achieve the metallic effect.)

O. Mil — Measure of film thickness equal to one-thousandths part of an inch

P. Mottling — Paint defect that occurs when metallic flakes float together, forming light and dark streaks

Q. Oxidation — Oxygen from air combining with paint film; also chalking of paint film that takes place in aging of film

R. Pitch — Angle of mica or metallic flakes in paint film

S. Retarder — Paint additive that slows paint curing or drying time

T. Tint tone — Shade resulting from mixing a color with paint in can

EXAMPLE: Blue-toned white

II. Basic ingredients in all paints

(NOTE: Although automotive paints may seem very different, they all have common ingredients. Actually the word *paint* is a broad term used to describe many different finishing materials. For instance *lacquer*, *enamel*, *primer*, *sealer*, and *putty* all apply to some form of paint. Because they are all paints, they have the following three ingredients in common.)

A. Pigment — Ingredient that gives paint its color

B. Binder — Ingredient that causes pigment to stick to automobile's surface

C. Vehicle — Ingredient in wet paint that thins it so that it can be sprayed

EXAMPLES: Thinner, reducer

(NOTE: Each paint product company offers several different vehicles for both lacquer and enamel paints. There are two main differences between any two vehicles: 1) how fast they evaporate, and 2) how much they dissolve and thin the binder in the paint.)

III. Types of finishes used on today's vehicles

A. Acrylic lacquer

(NOTE: Acrylic lacquer is presently used by General Motors on its automobiles. A favored OEM and repair finish, it is used for spot and panel repair of both lacquer and enamel original finishes and in overall repainting. When used over enamel, a sealer is recommended.)

B. Acrylic enamel

(NOTE: Acrylic enamel is presently used by American Motors Corporation, Chrysler, and Ford Motor Company on their automobiles. It is generally recommended for panel repairs and overall painting. This enamel is developed for optimum properties without additives, but can be used with hardener for high gloss and superior durability.)

C. Polyurethane enamel

(NOTE: This paint uses a special plastic binder that sets up chemically when an activator is added to the paint. With the activator mixed in, this paint may set up in the paint gun in as little as two hours if the temperature is high; therefore, the spray gun must be thoroughly cleaned immediately after use.)

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D. Water-based acrylic enamel

(NOTE: This finish, introduced by General Motors in the late 1970s, uses water instead of a chemical vehicle. The paint is repaired in the usual manner, with one exception. The finish must be sanded and a sealer applied before the repair paint is sprayed on. A spot repair cannot be made on water-based enamel.)

E. Clear acrylic (clearcoat)

(NOTE: The finish process called *basecoat/clearcoat* is made up of two coats of highly pigmented enamel, followed by two coats of clear acrylic. The resulting finish has a mirror-like luster and, in addition, minor scratches that do not penetrate to the colorcoat can be buffed out of the clearcoat.)

F. Urethane paint for flexible body parts

(NOTE: Urethane paint for flexible body parts, sometimes called *flex paint*, is specially formulated for use on flexible trim and rubber or urethane body parts. There are also special urethane additives that can be used with either lacquer or enamel paints to give the resulting paint film sufficient flexibility.)

CAUTION

Urethane and polyurethane paints contain isocyanate (cyanic acid, an ingredient of plastics and adhesives), which is very harmful if breathed. Always wear an OSHA-approved respirator when spraying paints.

G. Vinyl paint

(NOTE: Many late-model automobiles use a vinyl, abrasion-resistant paint coat on the lower body panels. This vinyl paint is sprayed on the lower panels before the color coat is applied. The vinyl paint gives the lower panels a rough look.)

IV. Comparison of acrylic lacquer and acrylic enamel paints

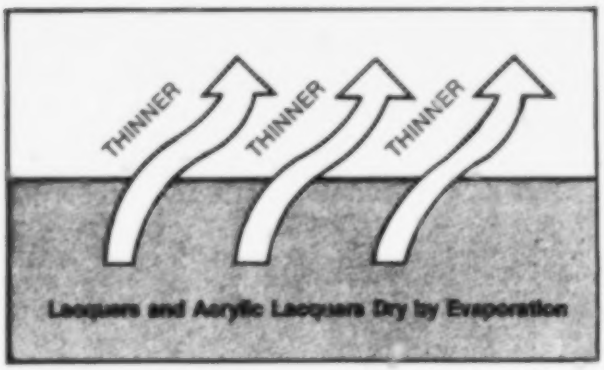
A. Acrylic lacquer paint

1. Uses thinner as vehicle

2. Contains resins and plasticisers and dries by evaporation of thinner only; therefore, pigments left on surface remain soluable (See Figure 1)

INFORMATION SHEET

FIGURE 1



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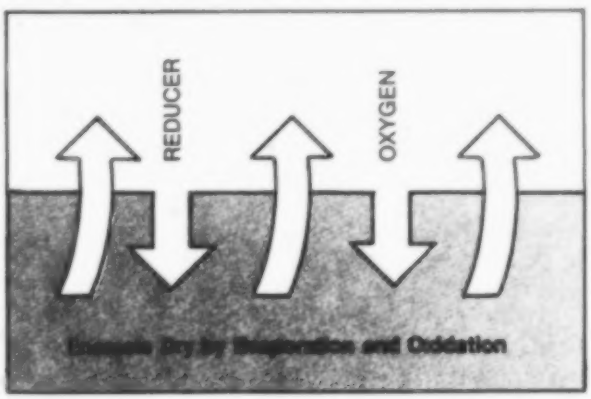
3. Dries without full gloss, so must be compounded and polished to make it shine
4. Primarily used for spot and panel repair over old lacquer or OEM enamel
5. Dries quickly
6. Does not hide very small chips, nicks, and sand scratches as well as does enamel
7. Requires more coats than enamel to get the desired finish

B. Acrylic enamel paint

1. Uses reducer as vehicle
2. Dries by evaporation of reducer and oxidation of binder to produce a hard, tough, durable surface (Figure 2)

FIGURE 2



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INFORMATION SHEET

3. Dries to a high gloss, so does not require compounding

   (NOTE: Enamel is fairly soft at first, and gradually hardens as the binder oxidizes. Because it takes up to a month or more for the binder to oxidize, enamel finishes should not be polished during that time.)

4. Primarily used for complete paint jobs over either lacquer or enamel

5. Dries slower than acrylic lacquers

6. Flows out well to cover very small chips, nicks, and sand scratches

7. Requires fewer coats than lacquer to get desired finish, but requires more skill to spray than lacquer

   (NOTE: Because enamels must flow out and dry to a glossy finish, *how* enamel is sprayed becomes important.)

V. Comparison of enamel paints

   A. Acrylic enamel

      1. Most popular enamel is use today

         (NOTE: Almost all new trucks are finished in acrylic enamel, and many new foreign and domestic automobiles have an OEM acrylic enamel finish.)

      2. Dries rapidly

      3. Normally dries to a high gloss, but may be compounded to eliminate slight orange peel

         (NOTE: For best results, acrylic enamel should not be compounded for 30 days after a paint job.)

      4. After it has cured about 6 hours, there must be a waiting period of about 1 week before recoating

      5. Covers well

      6. Paint defects can be corrected with compounding, which is much faster than sanding and then repainting

   B. Polyurethane/urethane enamel

      1. Is a mixture of alkyd enamel and clear urethane

      2. Urethane additive produces a hard, durable, surface

      3. Dries to a high gloss, *wet* look that requires no compounding

INFORMATION SHEET

4. Has extremely short drying time

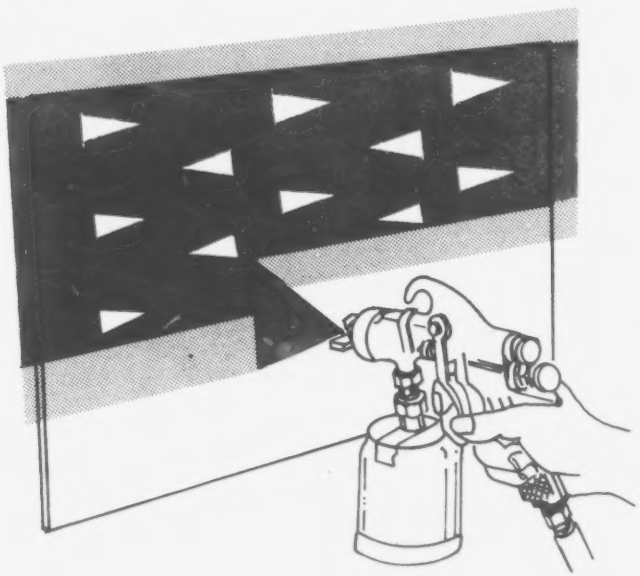
5. Must be mixed according to manufacturer's directions and requires no vehicle but may require a retarder to slow paint's drying time

6. Requires spray gun skill (because of short drying time) and an OSHA-approved respirator to protect technician from isocyanates

VI. Descriptions of coat application techniques

A. Single coat — Spraying coat so that each pass overlaps the previous one (Figure 3)

FIGURE 3



B. Double coat — Repeating single-coat application immediately

(NOTE: Generally two or more double coats are used to apply a lacquer topcoat, while at least two single coats are required for enamels. The first single coat should be allowed to become tacky before the second is applied.)

C. Mist coat — Spraying rich, slow-drying thinner or reducer with litle or no color added

(NOTE: The mist coat is used to runout or level the final coat and to melt in overspray. Uniforming finishes or blending clears are also applied as mist coats in the spot repair of acrylic lacquers.)

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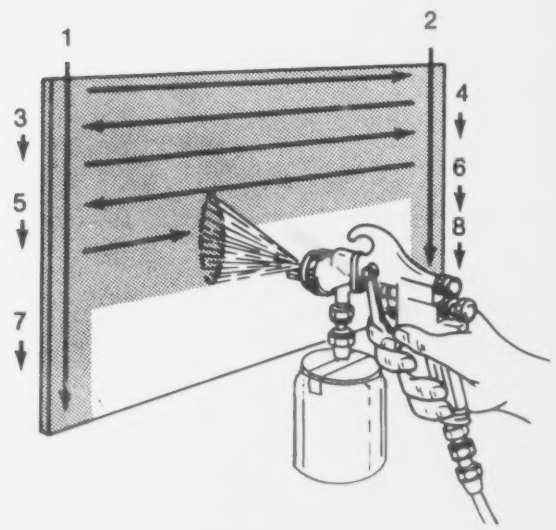
D. Banding coat — Applying single color coat in a small spray pattern to frame in an area to be painted (Figure 4)

(NOTE: Sometimes a banding coat is thinned more than the normal application that follows it. This is especially true when the paint to be sprayed is of high viscosity. The additional thinning of the paint allows it to fully enter cracks and seams. A good example is the application of textured vinyl finish.)

FIGURE 4



Adapted with permission of Binks Manufacturing Company.

VII. Degrees of coat thickness of sprayed paint

(NOTE: The easiest way to control the degree of paint thickness is to control the speed [stroke] with which the paint gun is moved. The slower the stroke, the heavier the coat.)

A. Dust (fog) — Very light, dry color coat

B. Dry — Light color coat

C. Medium — Standard or average color coat

D. Wet — Heavy color coat

VIII. Causes of the most common paint application problems

A. Runs and sags — Gun held too close or moved too slowly; may also be caused by too much paint flow or too little air pressure

INFORMATION SHEET

B. Starved or thin film — Gun held too far away or moved too rapidly; may also be caused by too little paint flow and too much air pressure

C. Dry spray or texture — Gun held too far from work, or too much air pressure

D. Faulty spray pattern — Usually caused by clogged spray gun holes (Figure 5)

FIGURE 5: Correct spray pattern

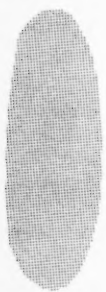


FIGURE 6: Faulty spray patterns

E. Excessive orange peel — Gun held too far from work, too much air pressure, or paint too viscous (thick)

F. Zebra effect — Gun tilted so that one part of spray reaches surface before rest of pattern

IX. Guidelines for preventing dirty paint

(NOTE: One of the biggest headaches in automotive refinishing is mysterious dust and dirt that seem to come from nowhere to mar freshly painted vehicles. This dirt can be prevented by the conscientious and careful refinisher who remembers to follow the guidelines listed below.)

A. Clean vehicle thoroughly with water, and then blow any dust from body seams and moldings with compressed air

(NOTE: Some refinishers take the time to steam-clean or pressure-clean the underside of the vehicle to ensure a clean, top-quality paint job.)

INFORMATION SHEET

B. Always wet down floor in paint booth before spraying

C. Complete all body work and most paint preparation outside of paint booth

D. Prevent drafts in paint booth by keeping doors closed after exhaust fan has been turned on

(NOTE: This requires planning. Take enough paint, tools, and materials into paint booth to complete the job. Leave the booth after painting only through the small doors at the fan end of booth, and leave the large doors closed for about 1 hour after finishing the paint job.)

E. Use clean equipment

F. Wear clean clothes

(NOTE: Wearing street clothes or untreated coveralls into the paint booth introduces dust in the paint work. Wear only starched coveralls, preferably of man-made cloth that has been treated with an antistatic product. If gloves are worn, they should be free of lint. Do not let improperly dressed people inside the booth.)

G. Prepare the paint properly

(NOTE: For best results, first mix the paint in its own container on a mixing machine and then mix the paint and vehicle in a separate *clean* can. Always strain paint into paint gun cup.)

H. Start painting at correct end of booth

(NOTE: When a complete paint job is being performed, start painting at the end of the booth opposite the end containing the exhaust fan. Then move along the vehicle toward the exhaust fan so that the spray mist [overspray] is pulled by the fan over the *unpainted* panels of the vehicle.)

I. Keep gun nozzle clean

(NOTE: Paint particles that build up on the nozzle should be wiped off often with a clean, lint-free cloth. If the nozzle is not cleaned, globs of built-up paint will blow onto and mar the surface being painted.)

J. Use clean masking materials

K. Use clean tack rags

L. Ground vehicle electrically to prevent static electricity from attracting dust

(NOTE: As soon as the vehicle is in the paint booth, it should be grounded with a wire run from the vehicle body or frame to a good ground such as a pipe. Do not ground the vehicle to the paint booth itself.)

MIXING AND APPLYING TOPCOATS
UNIT V

STUDENT SUPPLEMENT #1 — TROUBLESHOOTER'S GUIDE FOR FINISH PROBLEMS

Check with your instructor if you have not been provided with this supplement.

MIXING AND APPLYING TOPCOATS
UNIT V

JOB SHEET #1 — COLOR-MATCH AND APPLY METALLIC PAINT

I. Equipment and materials

A. Metallic paint and hardeners

B. Thinners and reducers

C. Paint agitator

D. Scrap panel for color testing

E. Color chip book

F. Air gun

G. Suction-feed spray gun

H. Clean, lint-free shop towels or paper towels

I. Paint paddle

J. Tack rags

K. Shading and tint color code charts

L. Eye protection and protective clothing

M. Respirator

(NOTE: Always use an OSHA-approved mask with a new cartridge. The vapor from catalyzed paint contains isocyanate, which can be very harmful to your lungs. Isocyanate breaks down the charcoal filter cartridges in the respirator; therefore, the cartridge must be changed frequently.)

N. Compound

II. Procedure

(NOTE: Metallic paint can be tricky to work with. The way it is sprayed on determines how light or dark the paint will be, and also how iridescent, or sparkling, it will appear. If the original paint must be matched, the painter must not only match the color of the pigment but must also spray the paint on correctly. This means that the technician must pay careful attention to the amount and type of additives used, the adjustment of the spray gun, and the spraying techniques used.)

JOB SHEET #1

A. Check paint code number or letters on body identification plate to determine exact type of paint needed

B. If vehicle has been repainted and does not have original factory paint, make the following test to determine paint type

   1. Apply small amount of lacquer thinner to clean, white rag

   2. Rub dampened rag on paint on fender lip or in other out-of-sight location near bottom of body

   3. Examine the rag: If paint colors rag, the paint is lacquer-type; if thinner curdles paint, causing it to lift and bubble, the paint is enamel-type

C. Use body identification plate color code to select correct shade of paint

   (NOTE: If vehicle has been refinished and color code chip does not match present color on vehicle, see Job Sheet #2, Step C2.)

D. Wet down paint booth floor

E. Put on protective clothing, eye protection, and respirator

F. Agitate paint on paint agitator for at least 10 minutes to ensure that pigment and metallic particles are well mixed

   (NOTE: While paint is agitating, set-up equipment and materials in paint booth.)

G. Push vehicle into paint booth, close booth, and turn on exhaust system

   (NOTE: If vehicle is pushed into paint booth, oily handprints must be washed clean with final cleaner before painting.)

H. Ground vehicle

I. Open can and stir paint gently with paint paddle to make sure that it is thoroughly mixed

   (NOTE: Pigment or metallic flakes left in the bottom of the can will cause a color mismatch.)

J. Add recommended amount of medium dry (mid-temp) or slow dry (low-temp) reducer, depending on shop conditions

K. Strain paint into paint gun cup

   (NOTE: Do not strain metallic paint through too fine mesh. The strainer may remove the metallic flakes and change the appearance of the finish coat.)

JOB SHEET #1

L. Blow and tack test panel

M. Holding gun at recommended distance from work, and using recommended gun pressure and spray pattern, spray test panel and allow it to dry

N. While panel is drying, wash a small area of the original paint on vehicle and polish it as necessary to remove any chalk and to bring up gloss

(NOTE: A low-gloss finish will reflect the light differently than a high-gloss finish and thus make color matching difficult.)

O. Compare test panel with original paint; if color is too light (dry), make one or more of the following adjustments

1. Open fluid adjustment on spray gun
2. Decrease spray gun fan pattern by adjusting fan-adjustment screw
3. Decrease air pressure to gun
4. Slow down speed of stroke (speed at which you move across repair area)
5. Decrease distance between gun and work
6. Use thinner or reducer that evaporates more slowly
7. Decrease time between coats

P. If the color is too dark (wet), make one or more of the following adjustments

1. Close fluid adjustment on spray gun
2. Increase fan pattern of gun
3. Increase air pressure at gun
4. Speed up speed of stroke (speed at which you move across repair area)
5. Increase distance between gun and work
6. Use thinner or reducer that evaporates more rapidly
7. Increase time between coats

Q. Spray number of coats recommended by paint manufacturer, allowing each coat to flash off for length of time recommended

JOB SHEET #1

R. Blend in overspray and apply mist coat

1. Thin or reduce paint to percentage recommended by manufacturer

   (NOTE: Thin or reduce with a slower drying vehicle than was originally used. Slower drying vehicles are used to melt in overspray.)

   EXAMPLE: If you used medium-dry (mid-temp) vehicle, change to slow-dry (low-temp) vehicle.

2. Reduce spray gun air pressure to that recommended by paint manufacturer

3. Blend in overspray, and finish with one or two mist coats

S. Allow topcoat to dry for length of time recommended by manufacturer

T. If lacquer topcoat has been applied, hand or machine compound to desired gloss

U. Clean paint gun and mixing implements (Job Sheet #1, Unit I, "Refinishing Equipment")

V. Clean work area and return equipment and materials to proper storage

MIXING AND APPLYING TOPCOATS
UNIT V

JOB SHEET #2 — COLOR-MATCH PAINT AND PERFORM A SPOT REPAIR

I. Equipment and materials

A. Lacquer thinner

B. Clean, lint-free shop towels and paper towels

C. Color chip book

D. Paint paddle and strainer

E. Paint gun

F. Blow gun

G. Masking paper or plastic and tape

H. Selection of paints

I. Reducer

J. Tack rags

K. Mixing containers

L. Eye protection and protective clothing

M. OSHA-approved respirator

(NOTE: Always use an OSHA-approved mask with a new cartridge. The vapor from catalyzed paint contains isocyanate, which can be very harmful to your lungs. Isocyanate breaks down the charcoal filter cartridges in the respirator; therefore, the cartridges must be changed frequently.)

II. Procedure

(NOTE: If the vehicle is finished with a clearcoat, it cannot be spot-repaired, but must instead be panel-repaired. See Job Sheet #3.)

A. Determine type of paint used on vehicle by interpreting manufacturer's paint code found on body identification plate

B. If vehicle has been repainted and does not have original factory-type paint on it, make the following test to determine paint type

1. Apply small amount of lacquer thinner to clean, white rag

2. Rub dampened rag on paint on fender lip or in other out-of-sight location near bottom of body

3. Examine the rag: If paint colors rag, the paint is lacquer-type; if thinner curdles paint, causing it to lift and bubble, the paint is enamel-type

C. Match color of paint already on vehicle

(NOTE: If matching metallic paint color, see Job Sheet #1.)

1. If matching original factory color, simply read color code on body identification plate, and then locate correct color in color chip book

(NOTE: If the color chip does not match the vehicle's color, the vehicle has been repainted in a color that is not the original color.)

2. If vehicle has been repainted and the color code is unknown, try to find a color chip sample that matches last color used

a. Place chip over clean, polished section of old paint on vehicle

b. Put water on polished section of old paint to give it the same high gloss as the chip

c. Determine whether the chip color is the same as the vehicle color

(NOTE: Be sure to judge the color in good light.)

d. When an exact match is found, use chip's color code to order paint for vehicle

(NOTE: If no color chip can be found that matches the vehicle's color, generally the vehicle has been painted with a special color or a mixture of colors.)

e. If no color chip matches the paint, remove a small painted part from vehicle and send it to an automotive paint store as a sample for custom mixing an exact color match

(NOTE: Normally, custom mixes cannot be returned to the paint store, so the refinisher must be certain that the customer has paid a deposit to cover the cost for custom mixing.)

D. Wet down paint booth floor

E. Put on protective clothing, eye protection, and respirator

F. Agitate paint on paint agitator for at least 10 minutes

JOB SHEET #2

G. Push vehicle into paint booth, close booth, and turn on exhaust system

(NOTE: Always push vehicle into paint booth to avoid sparks that may ignite the paint fumes. Once in the booth, clean off oily handprints with final cleaner.)

H. Ground vehicle

I. Mix paint with proper thinner or reducer for shop temperature, following label directions and cautions

CAUTION

Stir paint thoroughly with paint paddle. Never agitate paint that contains thinner or reducer as agitation may cause can to explode.

J. Strain paint into paint gun cup

K. Adjust paint gun pressure and spray pattern according to manufacturer's specifications

L. Blow and tack area to be painted

M. Hold gun recommended distance from work and spray specified number of full wet coats, each a little wetter than the previous one and each extending past the last coat

N. Allow first coats to flash for length of time recommended, and then wait 10 to 15 minutes

O. Apply remaining wet coats, extending each well beyond the first coats and allowing recommended time for flash off

P. Blend in overspray and apply mist coat

1. Thin or reduce paint to percentage recommended by manufacturer
2. Lower spray gun air pressure to that recommended by paint manufacturer
3. Apply mist coat

Q. Allow paint to dry for length of time recommended by manufacturer

R. While finish is drying, clean paint gun and mixing implements

S. Clean work area and return equipment and materials to proper storage

MIXING AND APPLYING TOPCOATS
UNIT V

JOB SHEET #3 — PAINT A PANEL

I. Equipment and materials

A. Automotive paint selection

B. Paint gun

C. Stirring paddles and paint strainer

D. Mixing containers

E. Reducers or thinners, depending on topcoat type to be applied

F. Clean, lint-free shop towels or paper towels

G. Tack rag

H. Masking paper or plastic and tape

I. Blow gun

J. Compound (if applying lacquer topcoat)

K. Buffer and compounding pad (if applying lacquer topcoat)

L. Eye protection and protective clothing

M. Color chip book

N. OSHA-approved respirator

(NOTE: Always use an OSHA-approved mask with a new cartridge. The vapor from catalyzed paint contains isocyanate, which can be very harmful to your lungs. Isocyanate breaks down the charcoal filter cartridges in the respirator; therefore, the cartridges must be changed frequently.)

II. Procedure

A. Inspect panel closely to make sure that it is properly undercoated and masked

(NOTE: Vehicle should be in paint booth.)

B. Adjust or repair masking as necessary

C. Determine type of paint used on vehicle and then make a color match (Job Sheets #1 and #2)

JOB SHEET #3

D. Mix paint with recommended reducer or thinner to proper viscosity

E. If using enamel paint, add recomended amount and type of hardener

F. Strain paint into spray gun cup

(NOTE: Do not strain metallic paint through too fine mesh. The strainer may remove the metallic particles from the paint and cause a color mismatch.)

G. Blow and tack panel

H. If applying lacquer paint, use the following application procedure

1. Adjust pressure at gun to that recommended by paint manufacturer
2. Hold gun specified distance from work and spray wet coats until color match is achieved, allowing each coat to flash off for recommended length of time
3. Empty paint cup and fill with clearcoat

(NOTE: The cup does not need to be washed before filling.)

4. Readjust air pressure at gun to that recommended by clearcoat manufacturer
5. Spray recommended number of medium coats over panel and allow to melt in for 3 to 5 minutes

CAUTION

Spray only number of coats recommended by clearcoat manufacturer. Too many clearcoats can alter the color of the colorcoat and later cause cracking and other problems.

6. Allow to dry for length of time recommended by paint manufacturer
7. While paint is curing, clean paint gun and mixing implements
8. Hand- or machine-compound panel to desired gloss (Unit VI, Job Sheet #1)

I. If applying enamel paint, use the following application procedure

1. Adjust pressure at gun to that recommended by paint manufacturer
2. Hold gun specified distance from work and spray prescribed number of coats, allowing each to flash off for recommended length of time
3. Empty paint gun cup and fill with recommended reducer

(NOTE: The cup does not need to be washed before filling.)

JOB SHEET #3

4. Readjust air pressure at gun to that recommended by paint manufacturer
5. Blend panel repair, using only reducer to melt in overspray
6. Finish with one or two mist coats over entire panel
7. Allow panel to dry for length of time recommended by paint manufacturer
8. While panel is drying, clean paint gun and mixing implements

J. Clean work area and return equipment and materials to proper storage

MIXING AND APPLYING TOPCOATS
UNIT V

JOB SHEET #4 — PERFORM A COMPLETE PAINT JOB

I. Equipment and materials

A. Vehicle that is masked, undercoated, and ready for topcoat

B. Appropriate paint

C. Paint gun

D. Paint paddle and strainer

E. Reducer or thinner

F. Eye protection

G. Respirator

(NOTE: Always use an OSHA-approved respirator with a new cartridge. The vapor from catalyzed paint contains isocyanate, which can be very harmful to your lungs. Isocyanate breaks down the charcoal filter cartridges; therefore, the cartridges must be changed frequently.)

H. Lint-free shop towels or paper towels

I. Tack rag

J. Compound (if vehicle is to be painted with lacquer)

K. Buffer and compounding pad (if vehicle is to be painted with lacquer)

L. Engine cover

M. Ground chain

II. Procedure

A. Closely inspect vehicle to make sure that it is clean, in good repair, and ready for topcoating

B. Check paint code number or letters on body identification plate to determine exact type of paint needed

C. If vehicle has been repainted and does not have original factory paint, make the following test to determine paint type

1. Apply small amount of lacquer thinner to clean, white rag

2. Rub dampened rag on paint on fender lip or in other out-of-sight location near bottom of body

3. Examine rag: If paint colors rag, the paint is lacquer-type; if thinner curdles paint, causing it to lift and bubble, the paint is enamel-type

D. Use body identification plate color code to select correct shade of paint

(NOTE: If vehicle has been refinished and color code chip does not match present color on vehicle, see Job Sheet #2, Step C2.)

E. Mix paint according to manufacturer's instructions

F. Put on protective clothing, eye protection, and respirator

G. Push vehicle into paint booth

(NOTE: Always push vehicles into and out of paint booth to avoid ignition sparks that might ignite paint fumes. Once in paint booth, clean oily fingerprints from vehicle with final cleaner.)

H. Attach ground chain to vehicle

(NOTE: The ground chain reduces static and keeps down dust.)

I. Position vehicle so that air flow is from one end to the other

J. Blow and tack vehicle to make sure that it is dust-free

K. Cover engine with engine cover to protect it from overspray

L. Determine spraying sequence

(NOTE: On most paint booths, the air flow is from one end of the vehicle to the other. It is a good procedure to start on the end of the vehicle closest to the air inlet and to proceed to the end of the vehicle closest to the air outlet. This sequence allows you to melt in all of the overspray as you paint. You may want to use one of the sequences shown in Figure 7.)

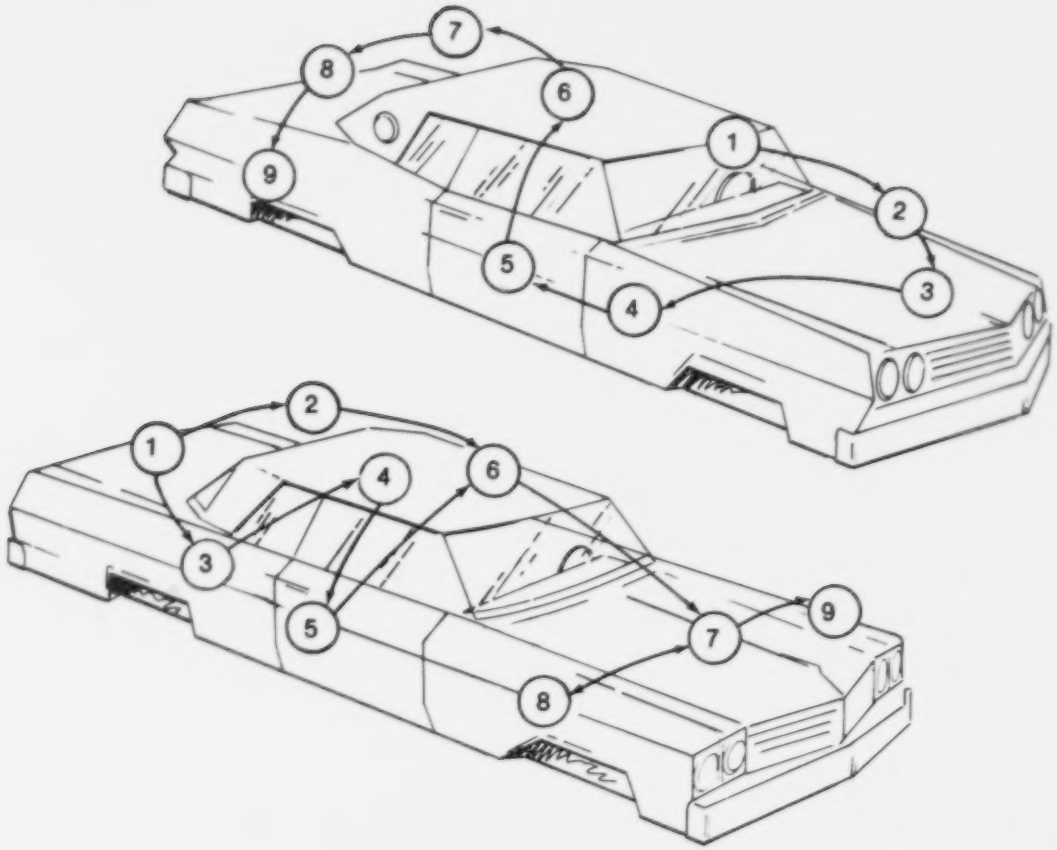
M. Before starting on main sequence, spray-paint all hidden surfaces such as door jambs, trunk bed edges, and hood edges, using low pressure to avoid overspray

N. Leave doors, trunk lid, and hood slightly ajar to permit them to dry without sticking

O. Paint sequence you are going to follow, remembering that the sequence chosen should minimize blending required on a panel between coats (Figure 7)

JOB SHEET #4

FIGURE 7



1. Strain mixed paint into paint cup
2. Adjust spray gun to pressure recommended by paint manufacturer
3. Apply paint, following application instructions, gun-to-surface distance, and number of coats recommended by manufacturer

   (NOTE: Try to paint complete panels with each coat.)

P. Allow topcoat to dry for length of time recommended by paint manufacturer

Q. If lacquer topcoat was applied, wet-sand with proper-grit abrasive and compound

R. Clean paint gun and mixing implements

S. Clean work area and return equipment and materials to proper storage

MIXING AND APPLYING TOPCOATS
UNIT V

JOB SHEET #5 — REPAIR WATER-BASED ACRYLIC ENAMEL

I. Equipment and materials

A. Sealer specifically formulated for application over water-based enamel before lacquer topcoat

B. Acrylic lacquer

(NOTE: Acrylic water-based enamel can be repaired with acrylic lacquer in the usual manner; however, the technician must sand the finish and apply sealer over the enamel before the lacquer is sprayed on.)

C. Wax and grease remover

D. Final cleaner

E. Appropriate-grit sandpaper and sanding block

F. Compound

G. Buffer and compounding pad

H. Bucket of water and Tide or other nonpetroleum-based detergent

I. Clean, lint-free cloths

J. Paint gun

K. Paint paddles and strainer

L. Thinner

M. Blow gun

(NOTE: All power equipment should be air operated.)

N. Eye protection

O. Respirator

(NOTE: Always use an OSHA-approved respirator with a new cartridge. The vapor from catalyzed paint contains isocyanate, which can be very harmful to your lungs. Isocynate breaks down the charcoal filter cartridges; therefore, the cartridges must be changed frequently.)

P. Masking paper or plastic, and tape

Q. Service manual for vehicle being worked on

JOB SHEET #5

II. Procedure

A. Check paint code number on body identification plate to make sure that vehicle has been painted with water-based acrylic enamel

(NOTE: If vehicle has been finished with water-based acrylic enamel, spot repairs are not possible. The complete panel to the nearest definition lines must be painted if paint repairs are made.)

B. Put on rubber gloves, eye protection, and respirator

C. Clean damaged panel with wax and grease remover, following directions and cautions on remover label

D. Mask panel at definition lines (Job Sheet #2, Unit III, "Masking")

E. Wet-sand with appropriate-grit sandpaper

(NOTE: Different refinishers recommend different grades of sandpaper for wet sanding, depending on the type of topcoat to be applied. For enamel, they recommend #320 paper. For lacquer, some recommend #400 paper. Others believe that the paper for wet sanding cannot be too fine. They recommend #600-grit paper.)

F. Wash and dry entire vehicle

G. Blow any remaining sanding dust from cracks near repair area

H. Check masking; remask areas that have become loose or wet during sanding and washing processes

I. Push vehicle into paint booth, close booth, and turn on exhaust system

J. Clean oily handprints from vehicle with final cleaner

K. Apply sealer recommended by manufacturer, following instructions and cautions on sealer label

1. Mix sealer and correct reducer according to manufacturer's instructions

2. Strain mixture into paint cup

3. Set spray gun air pressure to that recommended by sealer manufacturer

4. Spray an even, medium coat of sealer on area

5. Allow sealer to dry for at least 15 minutes, but less than 1 hour

6. Wipe sealed area with a tack rag

JOB SHEET #5

L. Use body identification plate color code to select correct shade of paint

(NOTE: If vehicle has been refinished and color code chip does not match present color on vehicle, see Job Sheet #2, Step C2.)

M. Mix acrylic lacquer paint to recommended percentage

N. Strain paint into paint gun cup and adjust gun to correct spray pattern and pressure

O. Spray recommended number of coats, allowing each coat to flash off for specified length of time

P. Allow to dry for length of time prescribed by paint manufacturer

Q. Attach compounding to pad buffer and compound panel until color is correct and panel has a deep glossy finish

R. Clean work area and return equipment and materials to proper storage

MIXING AND APPLYING TOPCOATS
UNIT V

JOB SHEET #6 — REPAIR A CLEARCOAT

I. Equipment and materials

A. Clearcoat

B. Paint gun

C. Stirring paddles and strainer

D. Reducer or thinner

E. Compound

F. Lint-free shop towels

G. Tack rag

H. Microfine sandpaper and sanding block

I. Buffer and compounding pad

J. Service manual for vehicle being worked on

K. Eye protection

L. Respirator

(NOTE: Always use an OSHA-approved respirator with a new cartridge. The vapor from catalyzed paint contains isocyanate, which can be very harmful to your lungs. Isocyanate breaks down the charcoal in filter cartridges; therefore, the cartridges must be changed frequently.)

M. Masking paper or plastic, and tape

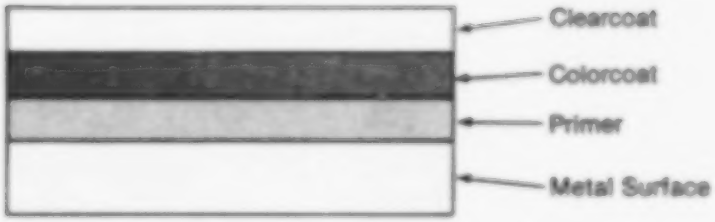
N. Final cleaner

II. Procedure

(NOTE: Many new cars are factory-finished using a two-step process to obtain the final finish. This process is called *basecoat/clearcoat*, or *colorcoat/clearcoat*. The topcoat is applied normally over the undercoats and then additional clearcoats are sprayed over the topcoat for a deep, lustrous, glossy finish. See Figure 8.)

JOB SHEET #6

FIGURE 8



A. Check paint code number or letter on body identification plate to make sure that vehicle has a clearcoat

B. Push vehicle into paint booth, close booth, and turn on exhaust system

C. Ground vehicle

D. Clean oily handprints from vehicle with final cleaner

E. Inspect damage to determine whether damage is in clearcoat itself or under clearcoat and in paint

F. If damage extends through clearcoat, refinish entire panel to nearest definition lines

1. Clean, blow dry, and mask as for normal surface preparation
2. Mix clearcoat and hardener or thinner according to manufacturer's directions and cautions
3. Strain mixed clearcoat into paint gun cup
4. Spray clearcoat, using pressure and number of coats recommended by paint manufacturer, and maintaining recommended spray technique and gun distance from surface

CAUTION

Spray only number of coats recommended by clearcoat manufacturer. Too many clearcoats can alter the color of the colorcoat and later cause cracking and other problems.

5. Allow clearcoat to dry for length of time specified by manufacturer

G. If damage consists of minor scratches and nicks in clearcoat only, simply wet-sand area with microfine sandpaper and sanding block, and then buff out any remaining scratches or nicks with compound, taking care not to buff through clearcoat

H. Clean work area and return equipment and materials to proper storage

MIXING AND APPLYING TOPCOATS
UNIT V

TEST

NAME _____ SCORE _____

1. Match to their correct definitions terms associated with automotive paint topcoats. Write the correct numbers in the blanks. Definitions are continued on the next page.

_____a. Paint additive that slows paint curing or drying time

_____b. Paint additive that speeds paint drying or curing time

_____c. The drying and hardening time for paint

_____d. Shade resulting from mixing a color with paint in can

_____e. Small particles of ground-up metal used in combination with paint; also paint containing such particles

_____f. Hand- or machine-rubbing of painted surface until it acquires high gloss or luster

_____g. Oxygen from air combining with paint film; also chalking of paint film that takes place in aging of film

_____h. Final layers of paint materials, such as lacquers or enamels, used to give automobile color and corrosion resistance

_____i. Paint defect in which old color seeps through paint topcoat

_____j. Self-leveling process of newly applied paint

_____k. Angle of mica or metallic flakes in paint film

_____l. Paint mixed and sealed in a can by paint manufacturer

_____m. Transparent topcoating applied over colorcoat to provide gloss and durability

_____n. Combining and integrating various paint coats

_____o. Measure of film thickness equal to one-thousandths part of an inch

1. Topcoat
2. Bleeding
3. Blending (melt-in)
4. Clearcoat
5. Compounding
6. Curing
7. Drier
8. Dry spray
9. Factory package
10. Flow-out
11. Film
12. Luster (gloss)
13. Mass tone
14. Metallic
15. Mil
16. Mottling
17. Oxidation
18. Pitch
19. Retarder
20. Tint tone

TEST

_____p. Small amount of paint in relation to spray gun air pressure; results in a light, thin dry paint film

_____q. Actual thickness of paint on a surface

_____r. Paint defect that occurs when metallic flakes float together, forming light and dark streaks

_____s. Shine or glow exhibited by painted surface

_____t. Color of paint as it appears in can

2. Match basic paint ingredients to their correct descriptions. Write the correct numbers in the blanks.

_____a. Ingredient that causes pigment to stick to automobile's surface

_____b. Ingredient that gives paint its color

_____c. Ingredient in wet paint that thins it so that it can be sprayed

1. Pigment
2. Binder
3. Vehicle

3. Name four types of finishes used on today's vehicles.

a. _____

b. _____

c. _____

d. _____

4. State facts about acrylic enamel and acrylic lacquer paints.

a. What is the name of the acrylic lacquer paint vehicle? _____

b. By what process(es) does acrylic lacquer paint dry? _____

c. Does acrylic lacquer paint require compounding or polishing? _____

d. Which dries more quickly, acrylic lacquer paint or acrylic enamel paint? _____

e. Which covers better, acrylic lacquer paint or acrylic enamel paint? _____

f. Which requires fewer coats and more spray gun skill, acrylic lacquer or acrylic enamel paint? _____

g. What is the name of the acrylic enamel paint vehicle? _____

h. By what process(es) does acrylic enamel paint dry? _____

_____

TEST

i. For what type of repair(s) is acrylic lacquer paint primarily used?_____

_____

j. For what type of repair(s) is acrylic enamel paint primarily used?_____

_____

5. State facts about types of enamel paints.

a. What is the name of the most popular enamel paint in use today?

_____

b. Which enamel paint dries to a wet look that requires no compounding?

_____

c. Which enamel paint has the faster drying time?_____

d. Which enamel paint may be compounded to eliminate orange peel?

_____

e. Which enamel paint requires no vehicle but may require a retarder to slow the paint's drying time?

_____

f. For which enamel must there be a waiting period of 1 week before recoating after the enamel has cured for 6 hours?

_____

g. Which enamel is a mixture of alkyd enamel and clear urethane?

_____

h. Which enamel requires the most spray gun skill and also requires an OSHA-approved respirator to protect the technician from isocyanates?

_____

6. Select correct descriptions of the following coat application techniques. Write the correct numbers in the blanks.

_____a. Single coat

1. Spraying coat so that each pass overlaps the previous one

2. Spraying coat so that each pass overlaps the previous two

3. Spraying coat so that each pass is parallel to the first but does not overlap

_____b. Double coat

1. Repeating single coat application after two-hour dry time
2. Repeating single coat application immediately
3. Repeating mist coat application after flash off

_____c. Mist coat

1. Spraying rich, slow-drying thinner or reducer with little or no color added
2. Applying single color coat in a small spray pattern to frame in an area to be painted
3. Spraying rich, slow-drying lacquer or enamel with little or no thinner or reducer added

_____d. Banding coat

1. Repeating single-coat application to outside edges of panel
2. Applying double wet coat in a large spray pattern to melt in an area to be painted
3. Applying single color coat in a small spray pattern to frame in an area to be painted

7. Describe degrees of coat thickness of sprayed paint.

a. Dust (fog) _____

b. Dry _____

c. Medium _____

d. Wet _____

8. Select causes of common paint application problems. Write the correct numbers in the blanks.

_____a. Runs and sags

1. Gun held too far away or moved too rapidly; may also be caused by too little paint flow and too much air pressure
2. Gun held too near work and too much air pressure
3. Gun held too close or moved too slowly; may also be caused by too much paint flow or too little air pressure

TEST

_____b. Starved or thin film

1. Gun held too far away or moved too rapidly; may also be caused by too little paint flow and too much air pressure
2. Usually caused by clogged spray gun holes
3. Tilting gun so that one part of spray reaches surface before rest of pattern

_____c. Dry spray or texture

1. Gun held too far from work, or too much air pressure
2. Gun held too far from work, too much air pressure, or paint too viscous (thick)
3. Gun held too near work, or too little air pressure

_____d. Faulty spray pattern

1. Usually caused by too much thinner or reducer
2. Usually caused by clogged spray gun holes
3. Usually caused by damaged metal surface

_____e. Excessive orange peel

1. Gun held too near work, or too little air pressure
2. Gun held at angle to work, or too little thinner or reducer
3. Gun held too far from work, too much air pressure, or paint too viscous (thick)

_____f. Zebra effect

1. Two different tints of enamel or lacquer paint
2. Usually caused by clogged spray gun holes
3. Gun tilted so that one part of spray reaches surface before rest of pattern

TEST

9. List eight guidelines for preventing dirty paint.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

   g. _____

   h. _____

(NOTE: Test item 10 lists the job sheets. They are an important part of this test. If they have not been completed, see your instructor.)

10. Demonstrate the ability to

    a. Color match and apply metallic paint.

    b. Color match paint and perform a spot repair.

    c. Paint a panel.

    d. Perform a complete paint job.

    e. Repair water-based acrylic enamel.

    f. Repair a clearcoat.

MIXING AND APPLYING TOPCOATS
UNIT V

ANSWERS TO TEST

1. a. 19
   b. 7
   c. 6
   d. 20
   e. 14
   f. 5
   g. 17
   h. 1
   i. 2
   j. 10
   k. 18
   l. 9
   m. 4
   n. 3
   o. 15
   p. 8
   q. 11
   r. 16
   s. 12
   t. 13

2. a. 2
   b. 1
   c. 3

3. Answer should include any four of the following

   a. Acrylic lacquer
   b. Acrylic enamel
   c. Polyurethane enamel
   d. Water-based acrylic enamal
   e. Clear acrylic (clearcoat)
   f. Urethane paint for flexible body parts
   g. Vinyl paint

4. a. Thinner
   b. Evaporation
   c. Yes
   d. Acrylic lacquer
   e. Acrylic enamel
   f. Acrylic enamel
   g. Reducer
   h. Evaporation and oxidation
   i. Spot and panel repairs
   j. Panel or complete paint jobs

5. a. Acrylic enamel
   b. Polyurethane/urethane enamel
   c. Polyurethane/urethane enamel
   d. Acrylic enamel
   e. Polyurethane/urethane enamel
   f. Acrylic enamel
   g. Polyurethane/urethane enamel
   h. Polyurethane/urethane enamel

6. a. 1
   b. 2
   c. 1
   d. 3

ANSWERS TO TEST

7. a. Very light, dry color coat
   b. Light color coat
   c. Standard or average color coat
   d. Heavy color coat

8. a. 3
   b. 1
   c. 1
   d. 2
   e. 3
   f. 3

9. Answer should include any eight of the following

   a. Clean vehicle thoroughly with water, and then blow any dust from body seams and moldings with compressed air
   b. Always wet down floor in paint booth before spraying
   c. Complete all body work and most paint preparation outside of paint booth
   d. Prevent drafts in paint booth by keeping doors closed after exhaust fan has been turned on
   e. Use clean equipment
   f. Wear clean clothes
   g. Prepare the paint properly
   h. Start painting at correct end of booth
   i. Keep gun nozzle clean
   j. Use clean masking materials
   k. Use clean tack rags
   l. Ground vehicle electrically to prevent static electricity from attracting dust

10. Performance skills evaluated to the satisfaction of the instructor

DETAILING
UNIT VI

UNIT OBJECTIVE

After completing this unit, the student should be able to detail vehicles after refinishing. The student will show this ability by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with automotive detailing.
2. Select correct descriptions of paint detailing products.
3. Distinguish between hand compound and macine compound.
4. List reasons for applying rubbing compound.
5. Match types of polisher/buffer pads to their correct uses.
6. State guidelines for quality detailing.
7. Demonstrate the ability to
   a. Compound, polish, and detail a complete lacquer paint job.
   b. Detail a complete enamel paint job.

DETAILING
UNIT VI

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1 — Compound, Polish, and Detail a Complete Lacquer Paint Job

2. Job Sheet #2 — Detail a Complete Enamel Paint Job

E. Test

F. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Order or obtain equipment and materials necessary to teach unit.

1. Equipment and materials for job sheet procedures

2. Examples of different detailing products

3. Examples of polisher/buffer compounding and polishing pads

4. Filmstrip *Compounding and Polishing* from series Auto Body Repair: Refinishing.

(NOTE: This filmstrip is available from Teaching Aids, Incorporated, Post Office Box 1798, Coast Mesa, California 92628-0798.)

5. Competency profiles

(NOTE: Competency profiles for this manual are available from the State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

C. Provide students with unit.

SUGGESTED ACTIVITIES

D. Introduce unit.

SUGGESTIONS:

- Discuss unit and specific objectives. Explain how mastery of the specific objectives leads to accomplishment of the unit objective.
- Explain that customers often judge the entire auto body repair based on the appearance of the topcoat. Returning a clean vehicle with a glossy topcoat to the customer is the best way of ensuring that the customer will return to the shop for future repairs.

E. Discuss information and job sheets.

1. Use Information Sheet, Section I to introduce students to terms associated with detailing.
2. Use Information Sheet, Section II to introduce students to products used for detailing.

   SUGGESTIONS:

   - Show students examples of each product outlined in this section of the information sheet.
   - Have students read the label instructions and cautions on a variety of products. Quiz them orally on their reading.
3. Use Information Sheet, Sections III and IV to discuss rubbing compounds.
4. Use Information Sheet, Section V to discuss types of polisher/buffer pads.

   SUGGESTIONS:

   - Show students samples of the two pad types.
   - Have students practice attaching pad to polisher/buffer.
   - Demonstrate the correct way of holding and moving the buffer. Allow students to practice using the buffer/polisher on a scrap panel.
5. Use Information Sheet, Section VI to discuss guidelines for quality detailing.

   - Show filmstrip *Compounding and Polishing*. Critique and discuss with the class.
   - Show students the results of not following the guidelines: dull finish, wrinkled paint, marred surfaces, etc.

SUGGESTED ACTIVITIES

6. Demonstrate and discuss job sheets. Assign completion dates. Have students perform Job Sheets #1 and #2 under your supervision.

F. Give test.

G. Critique test and discuss with class.

III. Unit references

A. Crouse, William H., and Donald L. Anglin. *Automotive Body Repair and Refinishing*, 2nd ed. New York: McGraw-Hill Book Company/Gregg Division, 1986.

B. Manual, Edward F., and Wayman R. Penner. *Auto Body Repair and Repainting*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, 1974.

C. Rhone, L.C., and H. David Yates. *Total Auto Body Repair*. 2nd ed. Indianapolis, Indiana: Bobbs-Merrill Educational Publishing, 1983.

DETAILING
UNIT VI

INFORMATION SHEET

I. Terms and definitions

A. Detailing — Cleaning interior and exterior of vehicle and polishing or compounding topcoat after spot, panel, or overall refinishing

B. Pumice — Very finely ground volcanic rock found in rubbing compounds

C. Nibs — Small specks of dirt in a dried paint film

D. Luster — Shine or glow exhibited by a painted surface

E. Orange peel — Uneven pebbly paint film resembling the skin of an orange

F. Overspray — Overlap of dry paint particles on an area where paint is not wanted

G. Polisher/buffer — Tool used to apply rubbing compound, polish, and some waxes to paint finishes

II. Paint repair and protection products

A. Wax and grease remover (precleaner) — Mild, solvent-type cleaner designed to clean a surface by breaking up or dissolving any dirt, wax, or silicones on the paint

B. Rubbing compound (cutting compound) — Abrasive paste containing pumice; used to smooth and polish paint

(NOTE: All rubbing compounds actually remove part of the paint. As some of the old paint is removed, the surface becomes smoother and more even. As this happens, the pumice itself is broken up. It polishes the paint to a finer smoothness as it is broken into smaller particles.)

C. Polish — Product containing both a cleaner and a silicone material; designed to remove grime and stains from topcoat and to restore or improve paint's gloss

D. Wax — Product containing silicone; used to help shine and protect topcoat

E. Cleaner/wax — Product containing both a polish and a wax; designed to smooth and wax vehicle in one operation

INFORMATION SHEET

III. Types of rubbing compound

A. Hand compound — Contains fairly coarse pumice grit; is applied with a rag or brush to small repair areas

B. Machine compound — Contains very fine pumice grit; is applied with a power polisher to large repair areas or to an entire vehicle

(NOTE: The two compounds should not be interchanged. The coarse particles in hand compound would create too much heat and friction if used with a power polisher.)

IV. Reasons for applying rubbing compound

A. To smooth the rough texture of new lacquer topcoats

B. To brighten and restore luster to an old finish

V. Types of polisher/buffer pads

A. Compounding pad — Used to work down heavy roughness on new lacquer paint and for general machine compounding; made of short lamb's wool (Figure 1)

EXAMPLE:

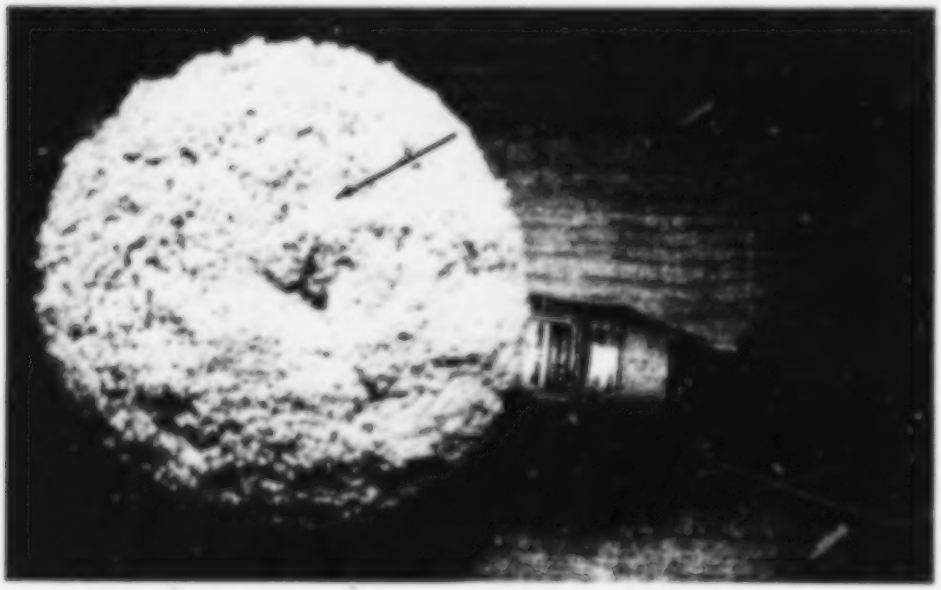
FIGURE 1

INFORMATION SHEET

B. Polishing pad — Used to "fine polish" a new surface after compounding; made of long lamb's wool (Figure 2)

EXAMPLE:

FIGURE 2



VI. **Guidelines for quality detailing**

A. Compounding

1. Always clean surface(s) with wax and grease remover before compounding
2. Compound *lacquer* paint only after it has been allowed to cure for at least 4 hours and preferably overnight
3. Do not compound *enamel* paint until it has completely cured

   (NOTE: Acrylic enamel does not cure for at least 30 days after application.)
4. When hand compounding, rub compound back and forth in a straight-line method, applying only enough pressure to make the "cut"
5. When machine compounding, always keep polisher/buffer moving to avoid burning the paint
6. Choose correct compound and correct buffer pad for job

7. Clean compounding pad frequently to remove paint and compound residue

B. Polishing

1. Do not polish either new lacquer or new enamel paint jobs
2. Always wash vehicle with soap and water and clean with wax and grease remover before polishing
3. Always use a clean, slightly damp cloth to apply polish
4. Allow polish to dry to a light-colored haze before hand or machine polishing
5. If hand polishing, turn cloth frequently so that dried polish does not rub on finish
6. If machine polishing, clean polishing pad frequently
7. When machine polishing, always keep polisher/buffer moving to avoid burning the paint
8. Never polish vehicle when vehicle is hot

C. Applying wax and cleaner/wax

1. Wax only after new topcoat has cured for at least 90 days or old topcoat has been compounded
2. Always wash vehicle with soap and water and clean with wax and grease remover before applying wax or cleaner/wax
3. Apply paste wax to small area at a time and wipe off immediately, unless manufacturer's directions say otherwise
4. Apply liquid wax to small area at a time, and wipe off with soft, dry cloth after product has dried to a light-colored haze
5. Wipe all excess wax from vehicle or it may dull the paint
6. Never wax vehicle when vehicle is hot

DETAILING
UNIT VI

JOB SHEET #1 — COMPOUND, POLISH, AND DETAIL A COMPLETE LACQUER PAINT JOB

I. Equipment and materials

A. Polisher/buffer

B. Compounding pad and polishing pad

C. #600 or finer sandpaper and sanding block or pad

D. Machine and hand compounds

E. Polish

F. Soft, clean cloths and shop towels

G. Air gun

H. Tire black paint

I. Tide or other nonpetroleum-based detergent

J. Bucket and sponges

K. Water hose

L. Glass cleaner and chrome cleaner

M. Lacquer thinner

N. Vacuum cleaner

O. Eye protection, rubber gloves, and rubber apron

P. Standard hand tools necessary for reinstallation of trim as necessary

II. Procedure

A. Remove masking from vehicle and discard in proper receptacle

B. Put on rubber gloves and apron

C. Thoroughly wash entire vehicle with detergent and water

D. Clean entire vehicle with wax and grease remover, following label instructions and cautions

JOB SHEET #1

E. Hand wet-sand vehicle with #600 or finer sandpaper

F. Wash off all sanding residue with water hose

G. Dry vehicle, blowing any remaining dust from crevices and trim with blow gun

H. Compound vehicle

1. Put on eye protection
2. Attach compounding pad to polisher/buffer and connect buffer to power source
3. Apply *macine compound* to small area of top panel, following manufacturer's instructions and cautions
4. Machine-compound area, holding polisher/buffer wheel at a slight angle while moving it back and forth

CAUTION

Keep the polisher/buffer moving. If you stop the polisher or allow it to stop on the surface, the paint will overheat and burn.

5. Clean compounding pad as necessary
6. Continue working around vehicle until top panel, hood, deck lid, and right and left sides are machine compounded
7. Use hand compound around small panels, windows, and bumpers, compounding any areas not accessible to polisher/buffer

I. Wash vehicle again with detergent and water to remove all compound residue

J. Use lacquer thinner to remove overspray from all chrome and metal parts

K. Polish chrome parts with chrome cleaner; reinstall

L. Vacuum, dust, and polish painted surfaces in trunk and vehicle interiors

M. Clean under hood to remove any overspray

N. Wash tires and wheel covers with detergent and water

O. Paint tires, if necessary, with tire black paint

JOB SHEET #1

P. Polish vehicle

1. Apply polish to entire surface of vehicle and allow to dry to a light-colored haze
2. Attach polishing pad to polisher/buffer, and connect buffer to power source
3. Machine polish accessible areas of vehicle exterior, cleaning polishing pad frequently
4. Hand polish areas inaccessible to machine polisher, turning polishing cloth frequently to avoid rubbing dried polish into finish
5. Clean all polish from cracks, body joints, louvers, moldings, and trim

Q. Clean interior and exterior surfaces of glass with glass cleaner and clean, lint-free cloth

R. Final dust vehicle with blow gun; inspect

(NOTE: A lacquer finish should not be waxed for at least 90 days following lacquer application.)

S. Clean work area and return equipment and materials to proper storage

DETAILING
UNIT VI

JOB SHEET #2 — DETAIL A COMPLETE ENAMEL PAINT JOB

I. Equipment and materials

A. Soft, clean cloths and shop towels

B. Air gun

C. Tire black paint

D. Tide or other nonpetroleum-based detergent

E. Bucket and sponges

F. Water hose

G. Glass cleaner and chrome cleaner

H. Lacquer thinner

I. Vacuum cleaner

J. Eye protection, rubber gloves, and rubber apron

K. Standard hand tools necessary for reinstallation of trim as necessary

II. Procedures

A. Remove masking from vehicle and discard in proper receptable

B. Put on rubber gloves and apron

C. Thoroughly wash entire vehicle with detergent and water; dry under hood

D. Remove overspray with lacquer thinner, following instructions and cautions on label

CAUTION

Lacquer thinner will remove new enamel finish. Take every precaution to keep it off the newly painted surface.

E. Remove overspray from all trim, chrome moldings and bumpers, and glass

JOB SHEET #2

CAUTION

Take care not to get lacquer thinner on any painted or plastic inserts. Lacquer thinner may remove paint from such moldings or trim.

F. Polish all trim and moldings; reinstall on vehicle

G. Polish bumpers and all interior painted surfaces

H. Vacuum and dust trunk and vehicle interiors

I. Wash tires and wheel covers with detergent and water

J. Paint tires, if necessary, with tire black paint

K. Clean interior and exterior surfaces of glass with glass cleaner and clean, lint-free cloth

L. Final dust vehicle with blow gun; inspect

(NOTE: Dust with a blow gun or a soft, clean dusting cloth. *Do not* use a shop towel as it will scratch the new finish.)

M. Clean work area and return equipment and materials to proper storage

DETAILING
UNIT VI

TEST

NAME _____ SCORE _____

1. Match to their correct definitions terms associated with automotive detailing. Write the correct numbers in the blanks.

_____a. Uneven pebbly paint film resembling the skin of an orange

_____b. Very finely ground volcanic rock found in rubbing compounds

_____c. Tool used to apply rubbing compound, polish, and some waxes to paint finishes

_____d. Cleaning interior and exterior of vehicle and polishing or compounding topcoat after spot, panel, or overall refinishing

_____e. Shine or glow exhibited by a painted surface

_____f. Overlap of dry paint particles on an area where paint is not wanted

_____g. Small specks of dirt in a dried paint film

1. Pumice
2. Detailing
3. Nibs
4. Luster
5. Orange peel
6. Overspray
7. Polisher/buffer

2. Select correct descriptions of paint detailing products. Write the correct numbers in the blanks.

_____a. Wax and grease remover (precleaner)

1. Product containing both a cleaner and a silicone material; designed to remove grim and stains from topcoat and to restore or improve paint's gloss
2. Mild, solvent-type cleaner designed to clean a surface by breaking up or dissolvin any dirt, wax, or silicone on the paint
3. Product containing abrasive paste designed to clean a newly painted surface

_____b. Rubbing compound (cutting compound)

1. Product containing silicone; used to help shine and protect topcoat
2. Product containing both a polish and a wax; designed to smooth and wax vehicle i one operation
3. Abrasive paste containing pumice; used to smooth and polish paint

_____c. Polish

1. Product containing both a cleaner and a silicone material; designed to remove grime and stains from topcoat and to restore or improve paint's gloss

2. Product containing solvent-type cleaners designed to clean a surface of dirt, wax, or silicone and to smooth and polish the topcoat

3. Product containing both a cleaner and a wax material; designed to smooth surface and protect topcoat

_____d. Wax

1. Product containing silicone; used to help shine and protect topcoat

2. Product containing pumice; used to help shine and protect topcoat

3. Product containing rubbing compound and polish; used to help shine and protect topcoat

_____e. Cleaner/wax

1. Product containing silicone; used to shine and protect topcoat

2. Product containing both a cleaner and a silicone material; designed to remove grime and stains from topcoat

3. Product containing both a polish and a wax; designed to smooth and wax vehicle in one operation

3. Distinguish between hand compound and machine compound. Write an "X" in the blank before hand compound.

_____a. Contains very fine pumice grit; is applied with a power polisher to large repair areas or to entire vehicle

_____b. Contains fairly coarse pumice grit; is applied with a rag or brush to small repair areas

4. List the reasons for applying rubbing compound.

a. _____

b. _____

TEST

5. Match types of polisher/buffer pads to their correct uses. Write the correct numbers in the blanks.

_____a.	Used to work down heavy roughness on new lacquer paint and for general machine compounding: made of short lamb's wool	1. Polishing pad 2. Compounding pad
_____b.	Used to "fine polish" a new surface after compounding; made of long lamb's wool	

6. State guidelines for quality detailing.

Compounding (State three guidelines.)

a. _____

b. _____

c. _____

Polishing (State three guidelines)

a. _____

b. _____

c. _____

Applying wax and cleaner/wax (State two guidelines.)

a. _____

b. _____

(NOTE: Test item 7 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

7. Demonstrate the ability to

   a. Compound, polish, and detail a complete lacquer paint job.

   b. Detail a complete enamel paint job.

DETAILING
UNIT VI

ANSWERS TO TEST

1. a. 5
   b. 1
   c. 7
   d. 2
   e. 4
   f. 6
   g. 3

2. a. 2
   b. 3
   c. 1
   d. 1
   e. 3

3. b

4. a. To smooth rough texture of new lacquer topcoats
   b. To brighten and restore luster to an old finish

5. a. 2
   b. 1

6. **Compounding** (Answer should include any three of the following)

   a. Always clean surface(s) with wax and grease remover before compounding
   b. Compound *lacquer* paint only after it has been allowed to cure for at least 4 hours and preferably overnight
   c. Do not compound *enamel* paint until it has completely cured
   d. When hand compounding, rub compound back and forth in a straight-line method, applying only enough pressure to make the "cut"
   e. When machine compounding, always keep polisher/buffer moving to avoid burning the paint
   f. Choose correct compound and correct buffer pad for job
   g. Clean compounding pad frequently to remove paint and compound residue

   Polishing (Answer should include any three of the following)

   a. Do not polish either new lacquer or new enamel paint jobs
   b. Always wash vehicle with soap and water and clean with wax and grease remover before polishing

ANSWERS TO TEST

c. Always use a clean, slightly damp cloth to apply polish
d. Allow polish to dry to a light-colored haze before hand or machine polishing
e. If hand polishing, turn cloth frequently so that dried polish does not rub on finish
f. If machine polishing, clean polishing pad frequently
g. When machine polishing, always keep polisher/buffer moving to avoid burning the paint
h. Never polish vehicle when vehicle is hot

Applying wax and cleaner/wax (Answer should include any two of following.)

a. Wax only after new topcoat has cured for at least 90 days or old topcoat has been compounded
b. Always wash vehicle with soap and water and clean with wax and grease remover before applying wax or cleaner/wax
c. Apply paste wax to small area at a time and wipe off immediately, unless manufacturer's directions indicate otherwise
d. Apply liquid wax to small area at a time and wipe off with soft, dry cloth after product has dried to a light-colored haze
e. Wipe all excess wax from vehicle or it may dull the paint
f. Never wax vehicle when vehicle is hot

7. Performance skills evaluated to the satisfaction of the instructor

Troubleshooters Guide

ACID AND ALKALI SPOTTING

Appearance
Spotty discoloration of the surface.(Various pigments react differently when in contact with acids or alkalies.)

Cause
Chemical change of pigments resulting from atmospheric contamination, in the presence of moisture, due to industrial activity.

Remedy
a. Wash with detergent water and follow with vinegar bath.
b. Sand and refinish.
c. If contamination has reached the metal or subcoating, the spot must be sanded down to the metal before refinishing.

Prevention
a. Keep finish away from contaminated atmosphere.
b. Immediately following contamination, the surface should be vigorously flushed with cool water and detergent.

Figure 83 — Acid Spot

BLEEDING

Appearance
Discoloration of the surface of refinish color.

Cause
Solvent penetration from fresh color material dissolves old finish, usually reds and maroons, releasing a dye that comes to the surface.

Remedy
a. Remove all color coats and recoat.
b. Or, allow surface to cure, then apply bleeder sealer and recoat.

Prevention
Apply bleeder sealer over suspected bleeder colors before spraying new color.

Figure 82 — Bleeding

BLISTERING

Appearance
a. Small swelled areas like a water blister on human skin.
b. Lack of gloss if blisters are minute.
c. Broken edged craters if the blisters have burst.

Cause
a. Rust under surface.
b. Painting over oil or grease.
c. Moisture in spray lines.
d. Trapped solvents.
e. Prolonged or repeated exposure of film to high humidity.

Remedy
Sand and refinish blistered areas.

Prevention
a. Thoroughly clean and treat metal.
b. Frequently drain air line of water.
c. Avoid use of overly fast thinners when temperature is high.
d. Allow proper dry time between coatings.

Figure 84 — Blistering

BLUSHING (Acrylics and Lacquer)

Appearance
The finish turns milky looking.

Cause
a. Fast thinners in high humidity.
b. Unbalanced thinners.
c. Condensation on old surface.

Remedy
a. Add retarder to thinner and respray.
b. Sand and refinish.

Prevention
a. Keep paint and surface to be painted at room temperature.
b. Select a good quality thinner.
c. Use a retarder or reflow solvent when spraying in high humidity and warm temperatures.

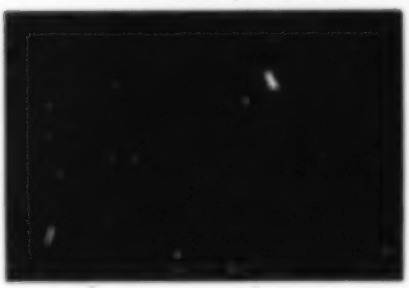


Figure 85 — Blushing

CHALKING

Appearance
a. Lack of gloss.
b. Powdery surface.

Cause
a. Natural weathering of paint films.
b. Lack of thorough agitation of paint.
c. Use of poorly balanced thinners create earlier failures.

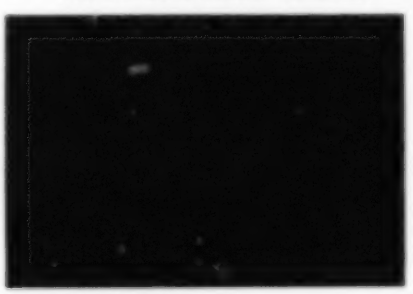


Figure 86 — Chalking

Remedy
Sand to remove soft surface material, clean and refinish.

Prevention
a. Agitate color coats thoroughly.
b. Use recommended DITZLER thinner for good balance.

CHECKING-CRAZING-CRACKING

Appearance
a. Crowfoot separation (check).
b. Formulation like shattered glass (crazing).
c. Irregular separation (cracking).

Cause
a. Insufficient drying of films prior to recoating.
b. Repeated extreme temperature changes.
c. Excessive heavy coats (cold checking).
d. Paint ingredients not thoroughly mixed.
e. Adding materials to a product not designed for it (incompatibility).
f. Recoating a previously checked finish.
g. Thinner attacking the strained surface of a cured acrylic lacquer (crazing).

Figure 87 — Line and Figure Checks

Remedy
Remove finish down through checked paint film and refinish.

Prevention
a. Follow proper drying times between coats.
b. Avoid extreme temperature changes.
c. Spray uniform coats, avoiding excess particularly with lacquers.
d. Mix all ingredients thoroughly.
e. Use only recommended balanced materials, thinners, etc.
f. Remove a previously checked finish before recoating.
g. Use DTL-151 DURACRYL thinner to help prevent crazing of acrylic lacquer.
h. Use DL-1970 sealer.

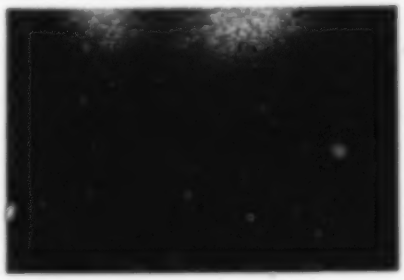


Figure 88 — Crazing

Figure 89 — Line Cracks and Crowfoot Checks

DIRT IN FINISH

Appearance
Foreign particles dried in paint film.

Cause
a. Improper cleaning, blowing off, and tack ragging of the surface to be painted.
b. Defective air regulator cleaning filter.
c. Dirty working area.
d. Defective or dirty air inlet filters.
e. Dirty spray gun.

Remedy
a. Rub out finish with DRX-25 Rubbing Compounds. (Not for enamels.)
b. If dirt is deep in finish, sand and compound to restore gloss. Metallic finishes may show mottling with this treatment and will then require additional color coats.

Prevention
a. Blow out all cracks and body joints.
b. Solvent clean and tack rag surface thoroughly.
c. Be sure equipment is clean.
d. Work in clean spray area.
e. Replace inlet air filters if dirty or defective.
f. Strain out foreign matter from paint.
g. Keep all containers closed when not in use to prevent contamination.

Figure 90 — Dirt in Finish

DULLED FINISH

Appearance
Gloss retards as film dries.

Cause
a. Compounding before thinner evaporates.
b. Using poorly balanced thinner or reducer.
c. Poorly cleaned surface.
d. Top coats put on wet subcoats.
e. Washing with caustic cleaners.
f. Inferior polishes.

Remedy
a. Allow finish to dry hard and rub with a mild rubbing compound.

Figure 91 — Dulled Finish

Prevention
a. Clean surface thoroughly.
b. Use recommended materials.
c. Allow all coatings sufficient drying time.

FISHEYES AND POOR WETTING

Appearance
a. Separation of the wet film.
b. Previous finish can be seen in spots.

Cause
a. Improper cleaning of old surface.
b. Spraying over finishes that contain silicone.

Remedy
Wash off paint while still wet.

Prevention
a. Clean surface with DX-330 wax and grease remover.
b. Use DX-66 fisheye preventer in finish coats to be sprayed over old films containing silicone.

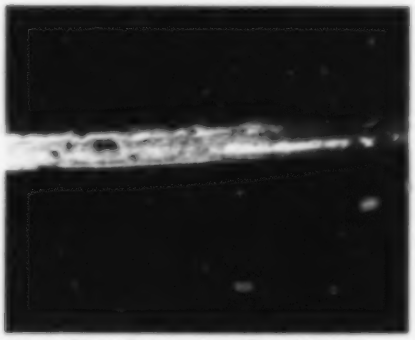


Figure 92 — Fisheyes and Poor Wetting

LIFTING

Appearance
a. Raising and swelling of the wet film.
b. Peeling when surface is dry.

Cause
a. Improper drying of previous coating.
b. Sandwiching enamel between two lacquers or acrylics.
c. Recoating improperly cured enamel.
d. Spraying over unclean surfaces.

Remedy
Remove lifted surfaces and refinish.

Prevention
a. Clean old surfaces thoroughly.
b. Allow all subcoats full drying time.
c. Seal old finishes.

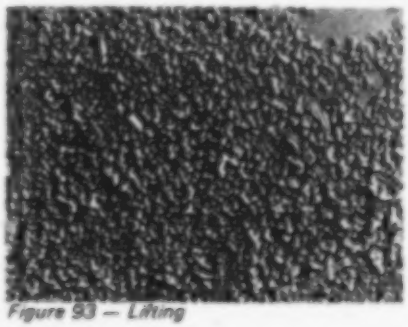


Figure 93 — Lifting

MOTTLING

Appearance
Streaking of the color. Generally associated with metallic finishes.

Cause
a. Excessive wetting of some areas.
b. Heavier film thickness in some areas.

Remedy
a. If color is freshly applied, back away and increase air pressure for final coat. Avoid over reduction.
b. On a dried finish, scuff down and apply additional color.

Prevention
a. Avoid excessive wetting or heavy film build-up in local areas.
b. Be careful not to over-reduce color.

Figure 94 — Mottling

ORANGE PEEL

Appearance
a. Resembles ball peen hammer dents in paint.
b. Resembles the skin of an orange.

Cause
a. Under reduction.
b. Improper thinning solvent.
c. Lack of proper flow.
d. Surface drying too fast.
e. Improper air pressure.

Remedy
a. (Enamel) Rub surface with a mild polishing compound. (Lacquer) Sand or use rubbing compound.
b. Sand and refinish.

Prevention
a. Proper air and gun adjustment.
b. Proper thinning solvents.

Figure 95 — Orange Peel

PEELING

Appearance
Separation of a paint film from the subsurface.

Figure 96 — Peeling

Cause
a. Improper surface preparation.
b. Incompatibility of one coat to another.

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Remedy
Remove peeling paint completely, prepare metal properly and refinish with compatible materials.

Prevention
a. Thoroughly clean and treat old surface.
b. Use recommended primers for special metals.
c. Follow acceptable refinish practices using compatible materials.

PIN HOLES OR BLISTERING OVER PLASTIC FILLER

Appearance
a. Pin point holes in finish.
b. Air bubbles raising the film causing craters when erupted.

Cause
a. Excessive amounts of hardeners.
b. Excessive vigorous stirring or beating in of hardener.

Remedy
Sand thoroughly and recoat with a glaze coat of Body Filler or DFL Putty.

Prevention
a. Mix in recommended quantities of hardeners.
b. Stir mildly, the hardener goes in quickly.
c. Work out possible air traps when applying filler.

PITTING OR CRATERING

Appearance
a. Small craters.
b. Like dry spray or over spray.

Cause
Same as Blistering (except blisters have broken).

Remedy
Same as Blistering

Figure 97 — Pitting or Cratering

Prevention
Same as Blistering

PLASTIC BLEED THRU

Appearance
Discoloration (normally yellowing) of the top coat color.

Cause
a. Too much hardener.
b. Applying top coat before plastic is cured.

Remedy
a. Remove patch, or —
b. Cure top coat, sand and refinish.

Prevention
a. Use correct amount of hardener.
b. Allow adequate cure time before refinishing.

Figure 98 — Plastic Bleed Thru

PLASTIC FILLER NOT DRYING

Appearance
Stays soft after applying.

Cause
a. Insufficient amount of hardener.
b. Hardener exposed to sunlight.

Remedy
Scrape off plastic and re-apply.

Prevention
a. Add recommended amount of hardener.
b. Be sure hardener is fresh and avoid exposure to sunlight.

RUST UNDER FINISH

Appearance
a. Peeling or blistering.
b. Raised surface spots.

Cause
a. Improper metal preparation.
b. Broken paint film allows moisture to creep under surrounding finish.
c. Water in air lines.

Remedy
a. Seal off entrance of moisture from inner part of panels.
b. Sand down to bare metal, prepare metal and treat with phosphate before refinishing.

Prevention
a. Locate source of moisture and seal off.
b. When replacing ornaments or moulding, be careful not to break paint film and allow dissimilar metals to come in contact. This contact can produce electrolysis that may cause a tearing away or loss of good bond with the film.

Figure 99 — Rust Under Finish

RUNS

Appearance
a. Running of wet paint film in rivulets.
b. Mass slippage of total film.

Cause
a. Over reduction with low air pressure.
b. Extra slow thinners.
c. Painting on cold surface.
d. Improperly cleaned surface.

Remedy
Wash off and refinish.

Prevention
a. Use recommended thinner at specified reduction and air pressure.
b. Do not paint over cold surface.
c. Clean surface thoroughly.

SAGS

Appearance
Partial slipping of paint in the form of curtains created by a film that is too heavy to support itself.

Figure 100 — Runs and Sags

Cause
- a. Under reduction.
- b. Applying successive coats without allowing dry time between coats.
- c. Low air pressure (lack of atomization).
- d. Gun too close.
- e. Gun out of adjustment.

Remedy
Sand or wash off and refinish.

Prevention
- a. Use proper thinner at recommended reduction.
- b. Adjust air pressure and gun for correct atomization.
- c. Keep gun at right distance from work.

SAND SCRATCHES

(Refer to Pages 20 and 21)

STONE BRUISES

Appearance
Small chips of paint missing from an otherwise firm finish.

Cause
- a. Flying stones from other vehicles.
- b. Impact of other car doors in a parking lot.

Remedy
- a. Thoroughly sand remaining paint film back several inches from damage point.
- b. Properly treat metal and refinish.

Figure 101 — Stone Bruises

UNDERCOAT SHOW THRU

Appearance
Variations in surface color.

Cause
- a. Insufficient color coats.
- b. Repeated compounding.

Remedy
Sand and refinish.

Prevention
- a. Apply good coverage of color.
- b. Avoid excessive compounding.

Figure 102 — Undercoat Show Thru

WATER SPOTTING

Appearance
- a. Dulling of gloss in spots.
- b. Mass of spots that appear as a large distortion of the film.

Cause
- a. Spots of water drying on finish that is not thoroughly dry.
- b. Washing finish in bright sunlight.

Remedy
Sand and refinish.

Prevention
- a. Keep fresh paint job out of rain.
- b. Do not allow water to dry on new finish.

Figure 103 — Water Spotting

WET SPOTS

Appearance
Discolored and/or slow drying spots of various sizes.

Cause
- a. Improper cleaning.
- b. Excessively heavy undercoats not properly dried.
- c. Sanding with gasoline or other chemically contaminated solvent.

Remedy
Sand or wash off thoroughly and refinish.

Prevention
- a. Clean surface with DX-330 wax and grease remover.
- b. Allow undercoats to dry thoroughly.
- c. Use only water as a sanding lubricant.

WRINKLING

Appearance
- a. Puckering of enamel.
- b. Prune skin effect.
- c. Loss of gloss as it dries (minute wrinkling not visible to the naked eye).

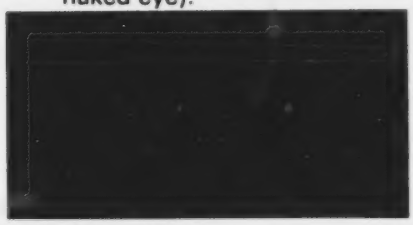

Figure 104 — Wrinkling

Cause
- a. Under reduction or air pressure too low causing excessive film thickness.
- b. Excessive coats.
- c. Fast reducers creating overloading.
- d. Surface drying trapping solvents.
- e. Fresh film subjected to heat too soon.

Remedy
Break open top surface by sanding and allow to dry thoroughly.

Prevention
- a. Reduce enamels according to directions.
- b. Apply as recommended.
- c. Do not force dry until solvents have flashed off.

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Proving and Testing Quality

Figure 123—More than 45,000 test panels are being exposed to Florida's subtropical climate. The number of panels has more than doubled in the past seven years. Plans are already underway to build a new test area this year to keep up with the demands of PPG's Research and Development groups.

One of the most difficult problems of the paint manufacturer is to completely evaluate the worth of its products. By that we mean that it is not easy to determine beforehand just how a paint product is going to stand up.

It may seem strange that since man can produce at will in the laboratory most of the conditions that cause paint failures such as high humidity, rapid changes in temperature, salt atmospheres, alkali deposits, and even the destructive rays of the sun, that we still have to rely upon nature to give the final approval. PPG has always recognized this fact and has equipped itself with the facilities and man power to make weather exposure tests under the most severe conditions that will be encountered by the paint film.

In addition to a complete set of laboratory apparatus for reproducing weather conditions which one would think were much more severe than any kind of weather, we have extensive exposure racks at Fort Lauderdale, Fla. for putting the paint films through their paces against Old Man Weather himself. There are so many panels being tested that it requires quite a staff of observers and technicians to analyze the results and keep the records.

In the laboratory we use salt sprays, alkaline solutions, extreme hot and cold tests by quick changing from refrigerator to oven and back again. Then there are bending tests, impact tests, and not the least by any means is the accelerated weather tester, a machine which carries the panels around on a cylinder into a water bath followed by a quick drying and heating process and the action of a powerful mercury arc light. This action is repeated every two minutes and the machine is allowed to run until some signs of failure are observed. It is said that twenty-four hours in this machine will duplicate months of weather exposure, but in spite of all this abuse, Old Man Weather still has something on the ball that the machine does not have.

Many chemicial and physical tests are made with each of the raw materials. Only these combinations of the raw materials that show promise of becoming useful in industry are subjected to exposure. Many are rejected before they get to the exposure test.

Coated panels are placed on sunracks, exposed in near horizontal position. This insures the maximum amount of sunshine. Each panel is washed frequently to prevent dirt accumulation which would shut out the action of the ultra-violet rays in the sunlight. These rays are the most destructive and washing is done to make the test more severe.

In order that any signs of failure may be noted as early as possible it is necessary that inspections be made very frequently. In searching for signs of failure each panel is examined under a microscope. For this work we have a staff of men and women at each location, especially trained in detecting failures, to make the examinations. As soon as a definite sign of failure is observed, one set of panels is returned to the laboratory for further microscopic study. Many of these tests take a year or more to get any results, while others begin to show signs of failure in a few months.

The result of all this is that PPG is able to maintain the quality of its products at a very high standard and is in a position to advise its customers and develop new products of proven worth for the markets of tomorrow.